Module 2

Sustainable Farming Practices

Learner Guide

Course Name	National Certificate: Animal /Plant Production SAQA ID: 48979/49009
Module Name	Module 2 Sustainable Farming Practices
Module Code	19200/20200
Unit Standards	116293; 116288; 116309; 12417; 116303; 116322; 116320, 119469
NQF Level	4

Table of contents

Dear Learner

This Learner Guide contains all the information to acquire all the knowledge and skills leading to the unit standard:

ID:	**Unit standard title:**
116293	Evaluate, adjust and implement factors influencing agricultural enterprises
116288	Execute sustainable resource use and quality control
116309	Implement integrated farm layout and site selection
12417	Measure, estimate & calculate physical quantities & explore, critique & prove geometrical relationships in 2 and 3-dimensional space in the life and workplace of adult with increasing responsibilities
116303	Implement a natural resource management plan
116322	Manage water quality parameters
116320	Plan and maintain environmentally sound agricultural processes
119469	Read analyse and respond to a variety of texts

You will be assessed during the course of your study. This is called formative assessment. You will also be assessed on completion of this unit standard. This is called summative assessment. Before your assessment, your assessor will discuss the unit standard with you. It is your responsibility to complete all the exercises in the Assessor Guide. The facilitator will explain the requirements of each exercise with you. You will also be expected to sign a learner contract in your assessor guide. This contract explains responsibility and accountability by both parties.

On the document "Alignment to NQF", you will find information on which qualification this unit standard is linked to if you would like to build towards more credits against this qualification. Please contact our offices if you would like information with regards to career advising and mentoring services.

Peritum Agri Institute

Office: 051-4511120

Enjoy the learning experience!

Key to Icons

	Important Information
	Quotes
	Personal Reflection
	Individual Formative Exercise
	Group Formative Exercise
	Summative Exercise
	Activity

CIN: 19200/20200 **Version: 001** **Date:2021/10/26**

Alignment to NQF

Element of programme	
1. Name of programme	Sustainable Farming Practices
2. Purpose of the programme	Form part of the qualification to equip learners in Animal/Plant Production
3. Duration of the programme	6 days of facilitation; 320 notional hours
4. NQF level	4
5. NQF credits	32
6. Specific outcomes	See Unit Standard Guide
7. Assessment criteria	See Unit Standard Guide
8. Critical cross-field outcomes	See Unit Standard Guide
9. Learning assumed to be in place	See Unit Standard Guide
10. Essential embedded knowledge	See Unit Standard Guide
11. Range statement	See Unit Standard Guide
12. Recognition of Prior Learning (RPL)	RPL can be applied in two instances: Assessment of persons who wish to be accredited with the learning achievements Assessment of learners to establish their potential to enter onto the learning programme.
13. Learning Materials	Learner Guide, Assessor Guide with Model Answers, Facilitator Guide, Learner PoE Workbook
14. Links of the programme to registered unit standards, skills programmes, or qualifications	Registered qualification: Title: National Certificate: Anima/Plant Production ID: 48979/49009

Unit 1:

Factors Influencing Agriculture

Unit Standard	
116293	Evaluate, adjust and implement factors influencing agricultural enterprises
Specific Outcomes	
SO 1: Evaluate and adjust production processes so that natural resources required are managed sustainably. SO 2: Compare and evaluate infrastructural factors affecting requirements. SO 3: Evaluate and adjust required stock. SO 4: Evaluate and adjust harvest procedures required. SO 5: Compare and integrate the post-harvest factors.	
CCFO's	
Identifying Working Organise Collecting	Science Communicating Demonstrating Contributing

MANAGEMENT OF NATURAL RESOURCES

Introduction

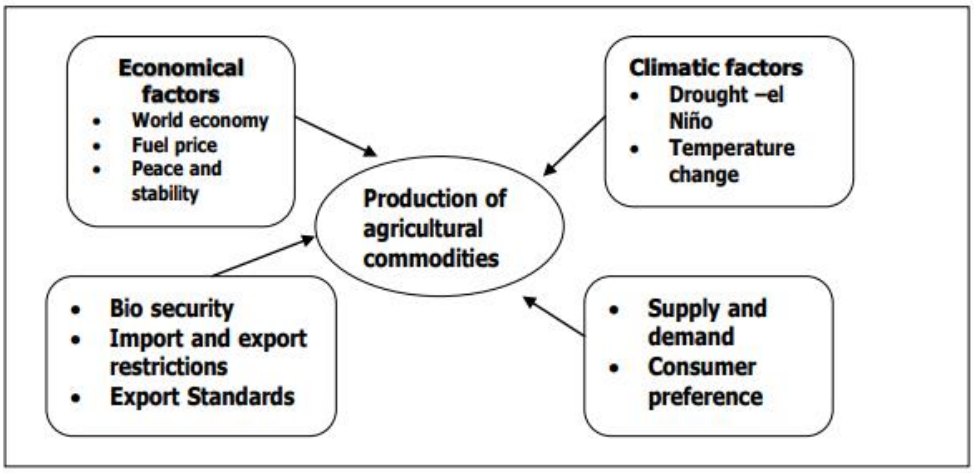
Production:

Production is the co-ordinating process which combines capital and labour in its various forms - raw materials, processed goods and equipment of al kinds, plant, technology, the workforce and management – in order to create a commodity. (Giles and Stansfield).

The production of Agricultural commodities is subjected to various internal production factors such as:

- International economic factors such as the fluctuation between the rand value against the dollar or pound.
- The international fuel price has an effect on the transportation and thus the production costs as a whole. • Diseases such as bird flu or Foot and Mouth affects the export of meat to other countries.

The production process is also influenced by external factors which the farmer\producer cannot control:
• Various climatic conditions according to the agri-ecological region the production takes place.
• The relative non-elasticity of the demand for the agricultural projects.
• The difficulty of agricultural production to adapt to changes in demand.
• Structural production changes require time.
• The importance of natural resources in the production process and the fact that land is the most important capital asset.
• Movable assets and agricultural products are non-durable and dispersed.
• The seasonal nature of agricultural production.



External factors influencing production of Agricultural commodities

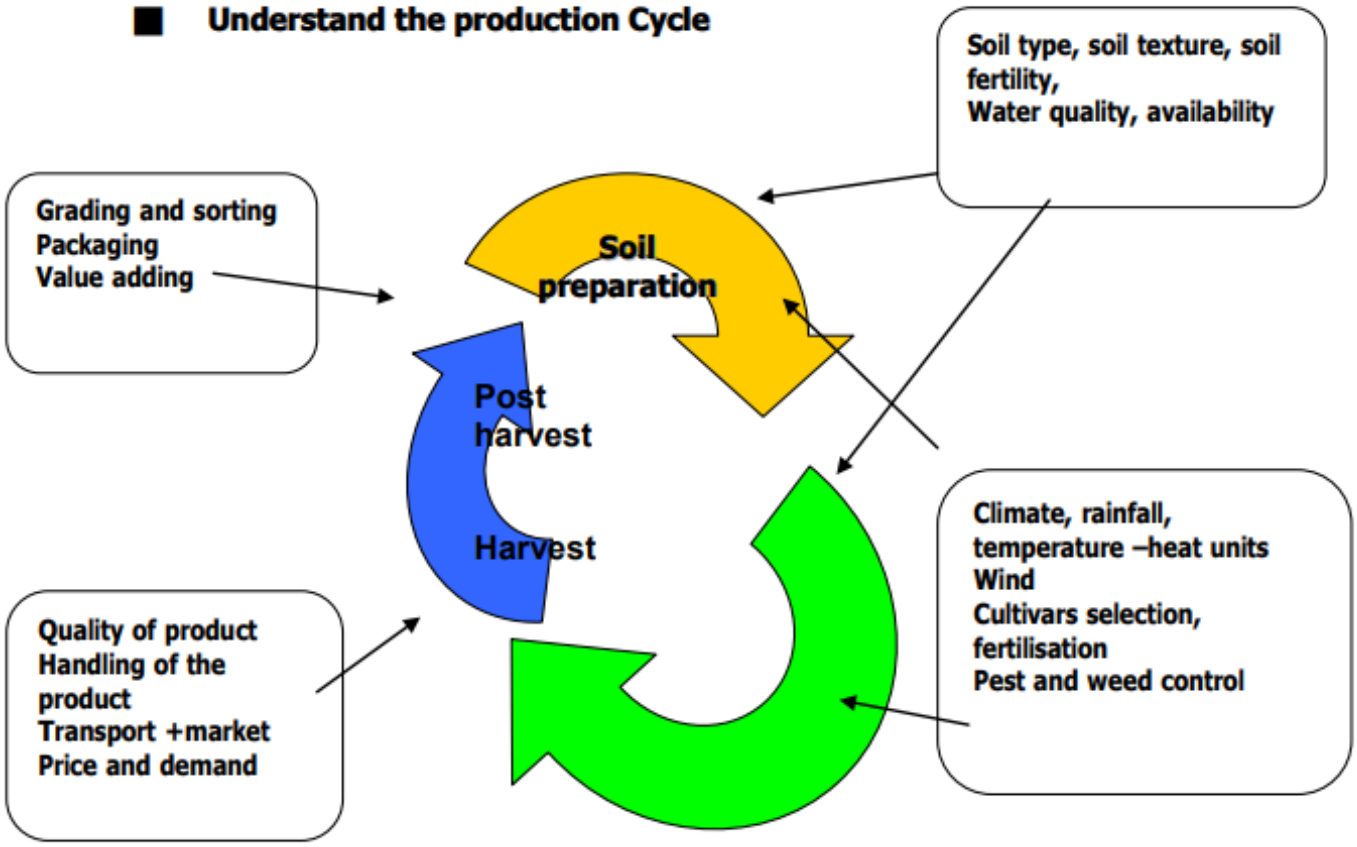
In order to produce a product that is of value and will full fill the needs of the market, the producer/ farmer/manager must take into account the external and internal factors. There are three essential ingredients in the production process to achieve the above:

- Building a production plan, one must have consider the marketing opportunities, availability of fixed resources and the production facilities available
- Obtain the necessary resources or a combination there-of and use it in the proper way
- Implement these plans and concentrate on the required levels of production and performance with appropriate supervision

The task of the farmer or the farm manager is to manage the production activities in such a way that the natural resources are used effectively; high production is attained; production costs at an acceptable ratio, that production systems are adapted to suit the climatic and economic environment. The productive use of these resources is one of the key areas to success. Natural resources include soil, water, climate, vegetation and topography.


Individual Formative 1


Individual Formative 2



Experience, judgement and intuition are valuable attributes to the farmer\producer in order to harmonise productivity and increased productivity economically.

Productivity is the rate at which goods are produced and the quantity produced in relation to work, time and money needed in the production process.

Optimal use is to exploit natural resources in such a way that the best production can be achieved without detrimental causes to these resources.

Efficiency can be sustained by ensuring that the relation between maximum production and cost effect is at the best level. There is no sense in applying more inputs than necessary as it will only increase the costs and not the production level.

If we want to stay on our farms and get rewarded for our work, we must farm with nature and we need to manage the natural resources in such a way that it will still be available for our children to enjoy the fruit of the land.

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SOIL AND WATER SAMPLES

The farmer or manager must know his soil to be successful in crop production. To be able to know the soil the farmer can send soil samples for analysis to determine the following:

• Soil type
• Nutrient status of the soil
• To determine the texture of the soil
• Recommendations for the specific crop to be planted

The farmer or the manager must be able to plan the cultivation program for the specific crop. Different tillage programs can be used in crop production, depending on the soil type, soil fertility and the crop to be produced.

Production systems

- No-till production system: With this system, the soil is left undisturbed from planting to harvesting. A prerequisite of this system is that 30% of the soil must be covered with plant residue after planting to reduce water erosion effectively. Weeds are chemically controlled by spraying e.g., Roundup. In most cases this system is combined with precision farming and movement of implements on one tract.
- Stubble-mulch tillage: This system implies that soil is tilled with a chisel plough or implements with discs, spring-tines and v-shaped blades before planting, but without burying or disturbing the plant residue on the land. Weeds are controlled chemically and /or mechanically.
- Reduced tillage: This system implies that any tillage system is used, but which leaves 15 – 30% of the soil surface covered with stubble. Weeds are controlled chemically or mechanically
- Conventional tillage: Conventional tillage usually implies a plough action or an intensive range of cultivations before planting. To maintain and conserve moisture, at least 50-60 % of the soil surface should be covered after planting.

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Major advantage and disadvantages of different tillage systems		
Tillage system	**Advantage**	**Disadvantage**
No-till	Lowest fuel consumption Quicker adaptation to optimum planting date Lower machinery cost Best control of wind and water erosion	Higher application of herbicide and intensive herbicide management necessary Requires: Higher management inputs Specialised or adapted implements More expensive equipment Possible compaction of soil and accumulation of nutrients in topsoil Earlier occurrence of leaf diseases Possible over-population of insects
Stubble mulching	Fuel saving compared to conventional tillage Good control/ better management of : Wind and water erosion Soil compaction Weed control	Soil preparation dependant on spring rains Greater possibility of leave diseases
Reduced tillage	Greater fuel economy than conventional tillage Control of : Wind erosion Insect population Accumulation of nutrients not a problem	Poor management of soil erosion Need better weed management
Conventional tillage	Good weed and insect control Lowest management input	Highest: Fuel consumption Machinery costs Waiting period for suitable soil water No control of water and soil erosion

When using any of these tillage systems, it is very important to ensure that a compacted layer, that may impair plant growth, does not occur in the effective root zone of the soil. If such a confined layer is detected, it should be broken by using a ripper implement to ensure better drainage, conservation and utilisation of water.

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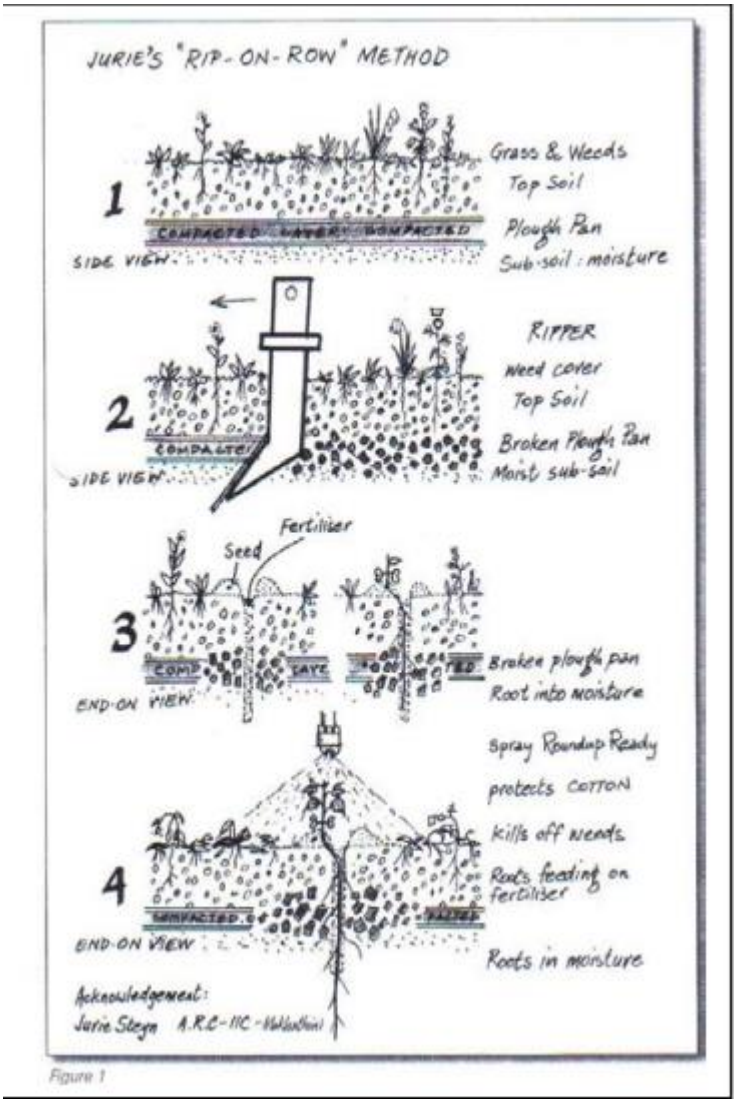

JURIE'S "RIP-ON-ROW" METHOD
1
Grass & Weeds
Top Soil
Plough Pan
Sub-soil : moisture
SIDE VIEW
2
RIPPER
Weed cover
Top Soil
Broken Plough Pan
Moist sub-soil
SIDE VIEW
Fertiliser
Seed
3
Broken plough pan
Root into moisture
END-ON VIEW
Spray Roundup Ready
protects COTTON
Kills off weeds
4
Roots feeding on fertiliser
Roots in moisture
END-ON VIEW
Acknowledgement:
Jurie Steyn A.R.C.-I.I.C. - Vaalharts
Figure 1

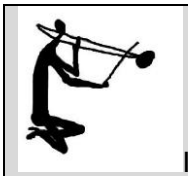
Precision farming

Precision farming is the use of modern technology - to collect data regarding the soil, environment and production - where the application of inputs is needed and thereby saving costs. The following example can explain this concept.

Step 1 - use a GPS (Global positioning system) to record the co-ordinates of your land and feed it into a computer. A map, showing the precise location and size of the field\land, is drawn.
Step 2 – take soil samples of the land. Every sample must be accompanied by a number and the co-ordinates (GPS). The results of the soil analysis are then fed into the computer to present a clear picture on the soil situation.
Step 3 – combine the info (from soil samples) and the requirements for a specific crop to determine the quantity and which fertiliser will be needed.

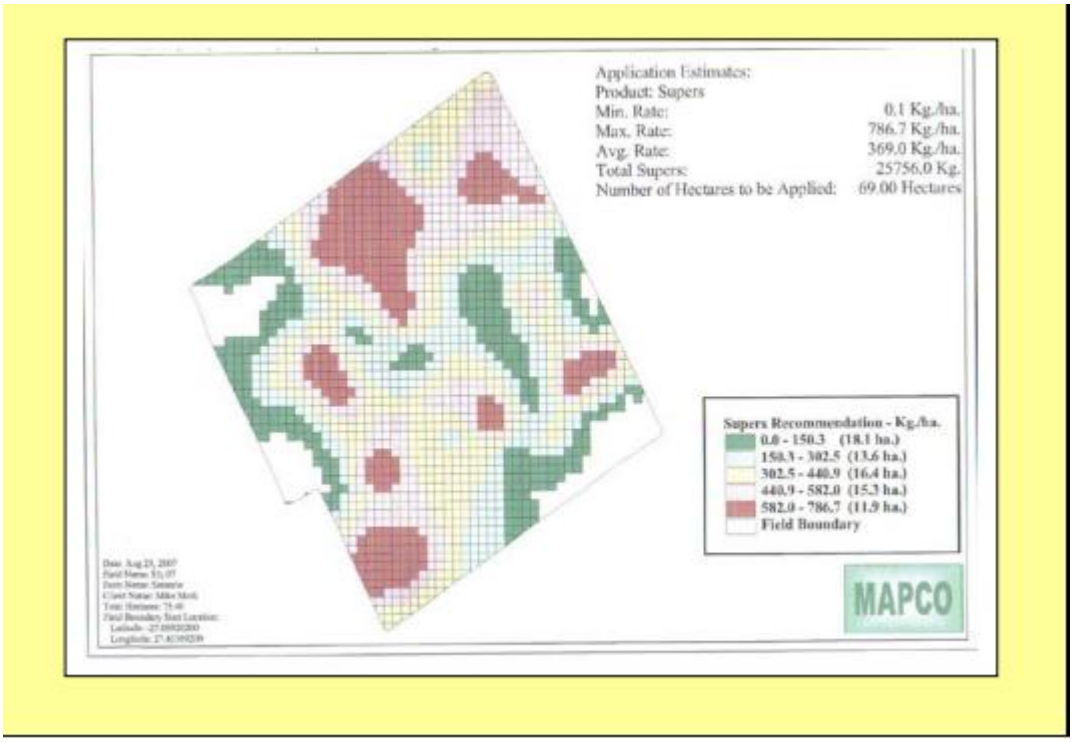
Soil samples are taken from the land with regular intervals. Each sample spot is marked with a GPS to plot the outcome on the land map.

The result of the soil analysis is indicated on the land map by using different colours – separating and showing areas with deficiencies in or beneficial nutrients.

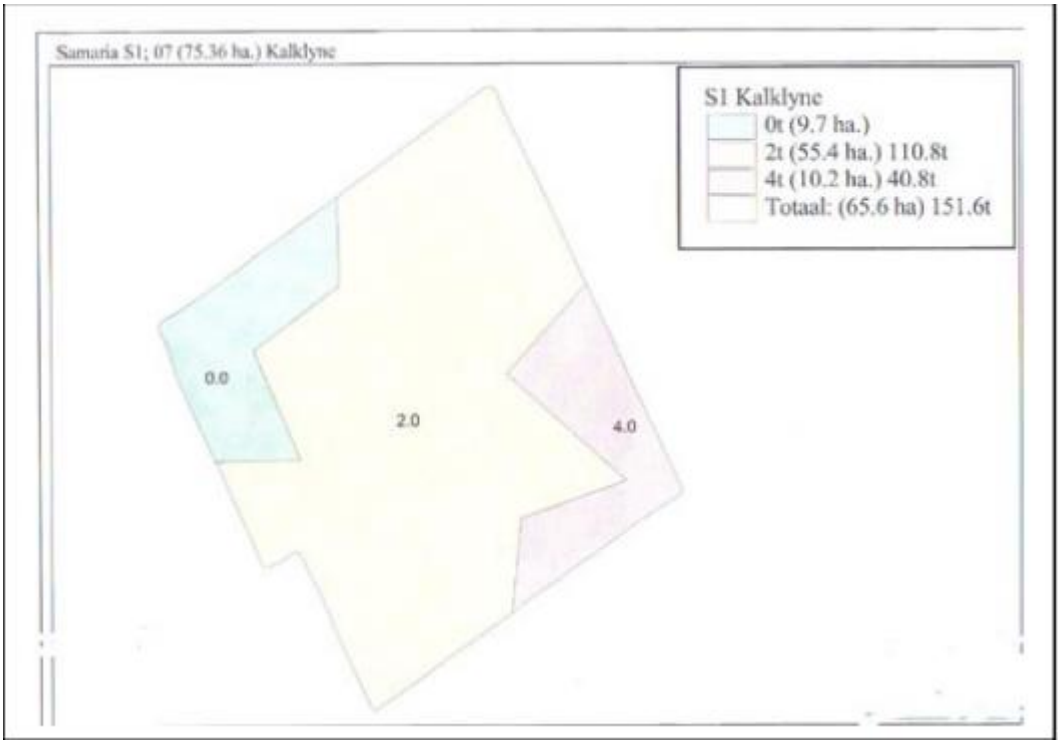


Individual Formative 3A

Individual Formative 3B



Planting equipment or fertiliser spreaders are fitted with sensors that interpret the information to adjust the application according to the land's fertiliser status or pH status. This ensures that shortages are addressed but also bring about a saving in the quantity of fertiliser applied. All the info collected provides the farmer with a clear picture and exact situation on the farm and enables him to determine the plant density and fertiliser application according to the soil and the expected yield.



The map will also indicate areas where lime must be applied, saving input costs as specific areas receive different applications and not one application for the land as a whole. When the crop is planted and sprayed, the information is also recorded and saved.

Precision farming also includes soil moisture sensors and climatic data collectors for irrigation areas to assist with the scheduling of irrigation.

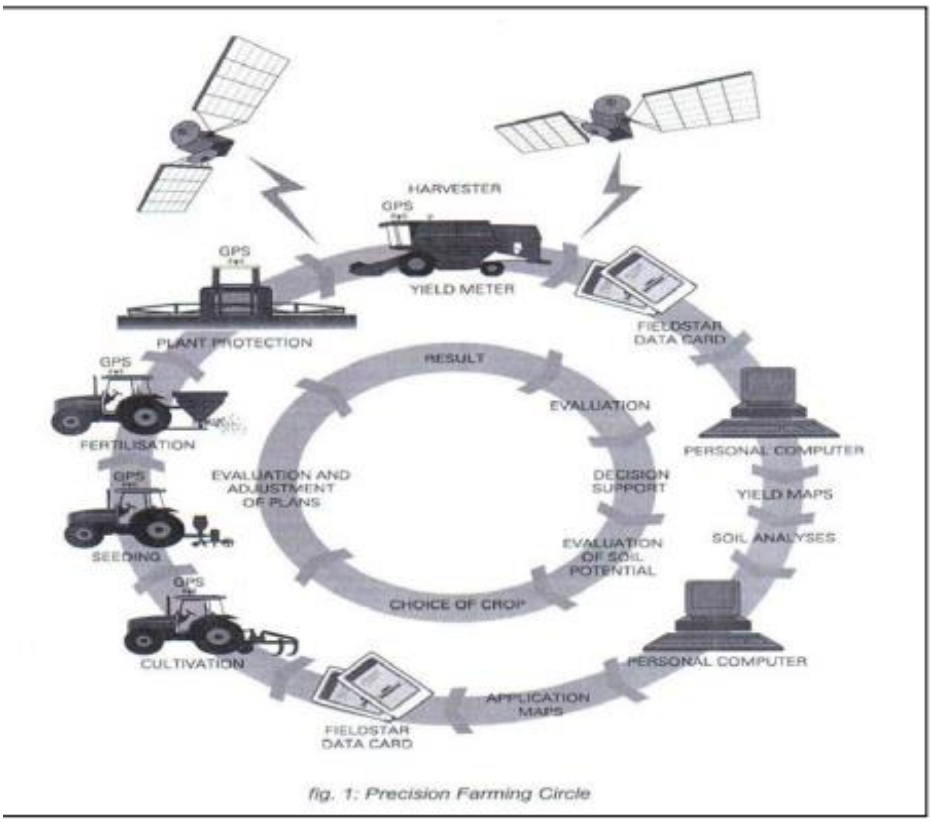


fig. 1: Precision Farming Circle

USE OF WEATHER FORECAST IN MANAGEMENT

Weather forecast is given on the radio, television and in the newspapers on a daily basis. If you have access to the internet you can get the forecast from the www.weatherforecast.co.za . You can even get the weather forecast on your cell phone by dialling 082162 and follow the prompts.

Progressive farmers have their own electronic weather station on the farm to provide them with information needed for various activities such as;

- Production planning for the next season by using long term predictions. (When to plant what.)
- Use the medium-term predictions to plan planting dates
- Short term predictions – weekly- to plan week‘s activities e.g., cutting of hay and the spraying of crops.
- Scheduling of irrigation is also a very important function where the weather stations and weather information play a very important role.

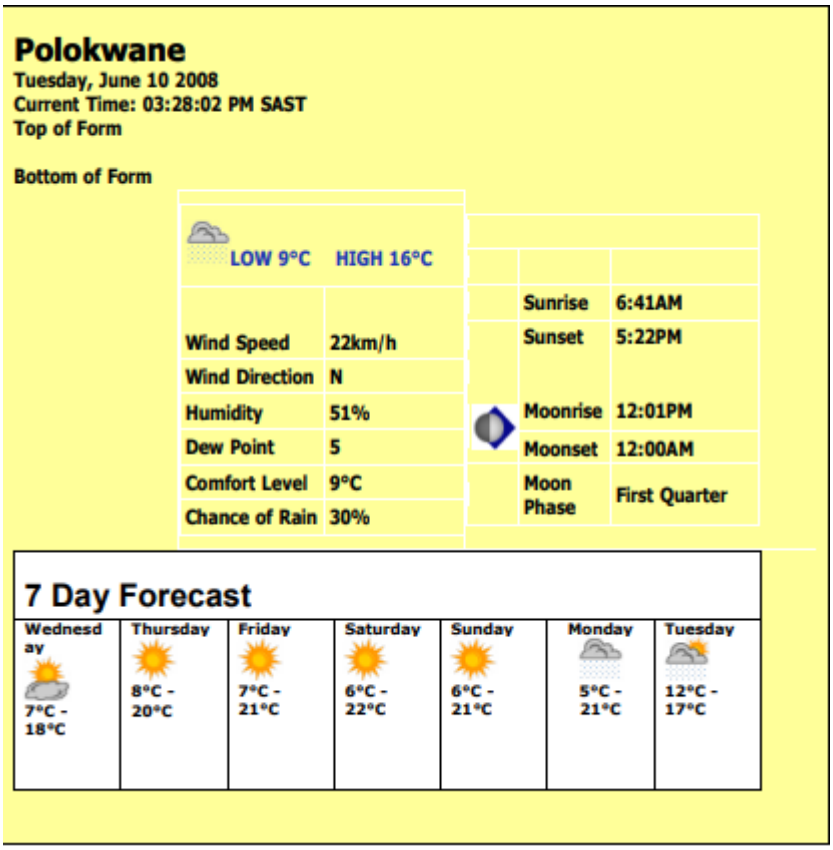
The South African weather service makes long, medium- and short-term predictions and the farmers should use this in their planning. Although the predictions may not be 100% accurate, it provides an indication of what to expect.

Producer's organisations such as SA Grain and the ARC (Institute for Soil, Water and Climate) also provide long term predictions to their members to assist them with the planning. Many farmers keep their own records to give them an idea what is happening on their own farm.

Weather information can also be obtained via internet from the following websites www.graansa.co.za www.arc.gov.za www.weathersa.gov.za

Types of forecast

The following is an example of the different types of forecasts that can be obtained from the SA Weather service



Polokwane
Tuesday, June 10 2008
Current Time: 03:28:02 PM SAST
Top of Form

Bottom of Form

LOW 9°C HIGH 16°C

Wind Speed	22km/h
Wind Direction	N
Humidity	51%
Dew Point	5
Comfort Level	9°C
Chance of Rain	30%

Sunrise	6:41AM
Sunset	5:22PM
Moonrise	12:01PM
Moonset	12:00AM
Moon Phase	First Quarter

7 Day Forecast

Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Tuesday
7°C - 18°C	8°C - 20°C	7°C - 21°C	6°C - 22°C	6°C - 21°C	5°C - 21°C	12°C - 17°C

- Long term predictions

The weather activities in other parts of the world and the water temperature at the south sea can influence the weather patterns in South Africa, Southern Africa and Australia. Very important is El Niño and la Niño patterns in the Pacific Ocean. El Niño pattern causes dry conditions in South Africa whilst the La Niño pattern has the opposite effect on the weather. It is important that the farmer take note of the

long-term predictions and also to look at the weather patterns in his area. To observe what is happening in nature, the farmer will also obtain information that can assist in decision making.

- Medium term predictions

Medium term predictions will provide information concerning the present production season. Farmers normally use this information to determine planting dates, plant density, top dressing or not and suitable cultivars for the production season. (The SA. Weather service is constantly busy to improve on their prediction techniques to provide better services to the public.)

- Short term

Short term forecasts are for a few days only, maximum a week. The forecast is normally made for three days or is given on a daily basis. This can be used to assist with activities such as harvesting, cutting of fodder and planting. The Weather service also issue warnings regarding the possibility of veld fires, approaching cold spells (to protect animals) and strong winds. Different equipment can be used to predict and record weather patterns. Modern technology makes it possible for more accurate predictions. It is very important to record the weather on a daily basis. This can be used for later reference and to assist in elimination of previous mistakes. (Some people observe the reaction of the insects, birds and wild animals to predict the weather.)

- Accuracy

No one can predict the outcome of certain weather patterns with 100 % accuracy. The Weather service makes use of models to do their predictions and work on probabilities. The weather patterns are observed, and according to the previous experience and available information the outcome is predicted. Patterns such as the influx of moist air from the tropical region can bring rain while a cold front moving over the country can cause rain in certain areas.

- Use of forecast
- The forecast obtained from the SA Weather service or any other weather service can be used for the following purposes:

• Planting or cultivation of crops
• Cutting or mowing of pastures or fodder crops
• Spraying of crops before rain to prevent the remedy being washed from the plants
• Wind direction and strength needed when you make fire breaks to prevent run away fires
• Temperature - when to protect plants and animals against cold weather
• Scheduling of irrigation - using wind, temperature and evaporation to calculate the amount of water needed
• Harvesting of certain crops – fruit

Individual Formative 4

Production processes

The production cycle processes are appraised, adjusted and incorporated into the relevant enterprises. Herewith are a few guidelines to follow during the different stages of the production process. The aim of production is to produce the best possible product at the most efficient cost. The production process can be more refined and improved as the producer gain more experience to determine what works well and what don't.

Crops	
Production Activity	**Activities**
1) Planning	**Plan the activities for the next season and draw up:**
	Land use plan
	Order the required inputs
	Ensure that tractors and equipment are in working condition
	Operators are trained in different activities **Labourers know what is expected – work hours arranged**
	Work out a work production schedule and get marketing agreements in place **Activity and equipment use plan**
2) Preparation phase	**Cultivation preparation - Primary and secondary cultivation**
	Ensure a good seed bed for the plants
	Record expenses and activities - ensure effective use of equipment
	Keep to time schedules
3) Planting phase	**Final land preparation**
	Supervise planting activities: **planter and spray equipment are correctly calibrated** **planting as decided – plant density, depth , fertiliser application, seed treatment (if necessary)** **correct working speed** **calibration tests - regularly at various places**
	Correct cultivars planted
	If permanent crops are planted e.g. trees make sure proper care is taken with the preparation of the soil
4) Germination	**Ensure that top soil is lose - if not loosen specially after a heavy rain storm** **Observe if germination takes place at the correct time** **Correlate % germinated plants with trial sample** **Re-plant areas with poor germination** **Look for cut worms, apply bait if necessary** **Cover where needed to protect young plants**

5) Growth stage	Record the different growth stages of the crop together with rainfall and the temperature If applicable - ensure irrigation during critical periods to eliminate stress Control weed and pests - to reduce stress Protection against pest and diseases Weed control
6) Pollination	Pollination is a critical period - ensure that there is enough plants for successful pollination Removal of unwanted materials Irrigation during this period essential
7) Fruit /grain setting	Plants must not be drought or heat stressed as it will effect fruit or grain setting negatively Where possible - ensure sufficient moisture to the plant
8) Harvesting	(Next to planting the most important phase) Make sure crop if ready to be harvested – not to early or to late. Dry enough – grain; or at the correct physiological stage – fruit & veggies Use correct harvesting methods Prevent breakage, damage or wastage
9) Post harvesting actions	Grading or classification of the products Correct packaging - according to different grades Pack only good quality, remove damaged products Make use of cold chain where necessary Transport - prevent damaging

Production economic principles

In the book Finance and the Farmers (Van Zyl, J(et al) of Standard Bank, planning is defined as " the managerial task that involves purposeful deliberation on the future objectives of a business or a section thereof, the means and activities involved, the problems that may be experienced and the formulation of the most suitable plan of action for the attainment of these goals"

Production planning primarily involves making choices and decisions - that means - selecting the most profitable and sustainable alternative for your production enterprise from other passable alternatives. There are many risks and uncertainties associated with farming. Detailed planning is therefore absolutely necessary. There are, as mentioned earlier, many factors that influence the production process and to assist the farmer or manager to make the correct decisions, production economics must be used and understood to assist with decision making.

Production economic principles comprise of a set of norms or rules that will ensure that choices or decisions will lead to maximum profit. The rules are applied in the following order or steps:

- Obtain and collect physical and biological data and process it into useful information
- Collect price data for the commodities produced and process it in useful data
- Apply the relevant economic rules regarding to decision making to achieve maximum profit

Marginality

Marginality is a very important concept in production economics. It explains how changes will affect a farming business - how changes in one factor will affect the profit or the economic situation as a whole - or how will the applications of additional fertiliser affect the crop results?

Marginality refers to an alteration of one factor (increase or decrease) in a process as the cause of the change of another factor - what will the additional income be? Marginal changes are calculated by determining the difference between the original value and the new value which resulted from the change in the controlled factor. The change in the input is indicated with Δ (the Greek letter delta)

E.g., changes in wheat production = Δ wheat production and Δ fertiliser

The second important concept in the production economics is the production faction. The production function indicates the relationship between different quantities or amounts of a specific output and a specific input, while all the other outputs stay the same or constant. This production function can be presented as a table, a graph or a mathematical equation.

$$Y = f(X_1, X_2, X_3, \ldots X_n)$$

Y = Output (maize production)

X_1 = Variable input (e.g. nitrogen fertiliser N)

$X_2, X_3, \ldots X_n$ = Inputs that remain constant (irrigation, cultivation, P +K)

The production function provides the basic data which could be used to make deductions from production.

The Total Production (TP) and the input level are required to determine the production. It can also be used to calculate the average production and the marginal production

$$\text{Average production} = \frac{\text{Total Production (TP)}}{\text{Input level}}$$

Average production is the total production divided by the input level. It is the production per input unit. The Average production will increase and then decrease as more units of the input is required

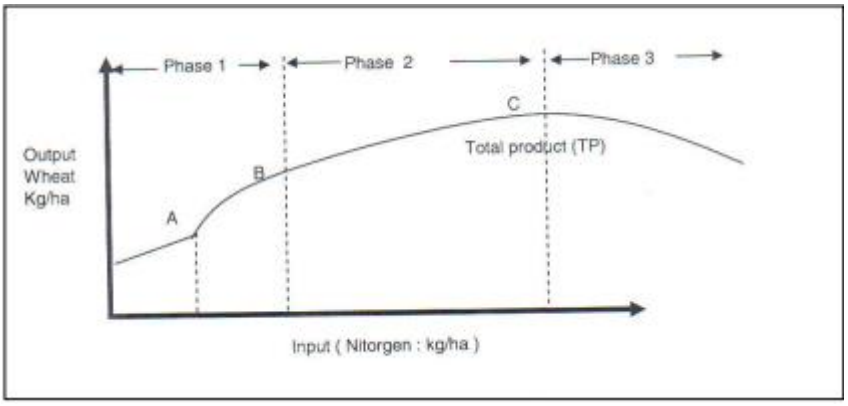
Input Level (n)	Total Production	Average Production $\frac{\text{Total Prod}}{\text{Input level}}$	Marginal Production Difference in production in n and n – 1 units of input
1	10	10	10
2	23	11.5	23 - 10 = 13
3	33	11	33 – 23 = 10
4	36	9	36 - 33 = 03
5	36	7.2	36 – 36 = 0
6	33	5.5	36 – 33 = - 3

$$\text{Marginal production (MP)} = \frac{\Delta \text{ Total production}}{\Delta \text{ Input level}}$$

The marginal production (MP) is the difference between the total productions (23 – 33 = 13), divided by the difference in the input level (2-1=1)

If 20 kg of N is applied, the average production will be 11.5 kg while the marginal production will increase to 13 kg. For every kg of N fertiliser added, the yield will increase with 13 kg up to 30 kg of N where the yield will only increase by 10 kg per kg N applied This can be illustrated in a graph.

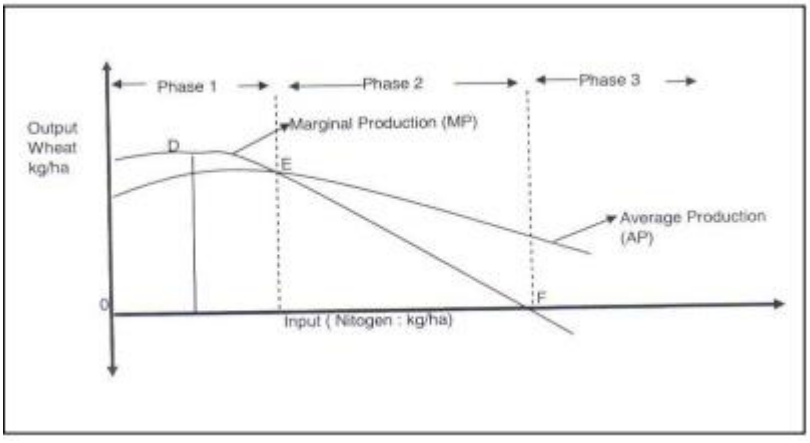
Graph.1 Typical production function in Agriculture



Production in the first phase indicates that the average production (AP) constantly increases. The marginal production (MP) is higher than the average.

Production: Maximisation of profit occurs constantly by adding additional units of fertilizer.

Graph 2 Marginal production and average Production



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In the Second phase the total production rate still increases, although in a decreasing way until it reaches point C where the increasing rate equals zero. The average production (AP) curve decreases throughout, as does the Marginal production (Mp) curve. The MP lies below the AP curve and MP = 0 at point
Point F correlates with point C on graph 1
In the third phase the total production starts to decline which means the MP curve is negative form point F onwards

Diminishing marginal returns

The law of diminishing returns states that, as additional units of a variable input are applied in combination with one or more fixed input(s), the marginal returns will eventually start to decrease.
For further evaluation of the production function the:

Input/output ration: - how much of an input or how much production is necessary to determine the most profitable input or production level.
• Profit involves money – thus, to maximise profits, income and costs must be considered. The price of inputs and output (product) must be known. The golden rule for decision making is: **The optimum input application level or the optimum production level is the level at which the maximum profit is achieved.** For maximum profit the marginal income (MI) should be equal to the marginal cost (MC).

Input /input ratios: - how to produce. The question to be asked is "Will another input combination produce the same result at a lower cost?" Will it be possible to substitute one input with another?
Four rates of substitution are possible:

• **A fixed rate of substitution** uses inputs in the production process according to a fixed ratio and no other substitution takes place - e.g., seed is treated with a specific fungicide or pesticide and non-other.

• **A constant rate of substitution** is where one input X_1 can always be substituted in the same ratio with other inputs X_2 in order to generate the same production - e.g., replacement of fertiliser with compost or manure at a constant rate of 5 parts manure to1part fertiliser

• **An increasing rate of substitution** is where the quantity of input X_1 increases, fewer and fewer units of X_2 must be used to replace one unit of input X_1. E.g., LAN fertiliser is needed for nitrogen, but urea can be used that is cheaper as long as it is done in the correct ration, as urea contains more N as LAN per unit.
• **A decreasing rate of substitution**: - as the quantity of X_1 decreases, more and more units of X_2 are required to replace one unit of input X_1 - e.g., the use of grazing (X_1) in comparison to a concentrate (X_2)

to produce milk - as the grazing decreases in nutritional value, the quantity of concentrates added to the cows' diet must increase to maintain the same production level.

Output/ output ratios - what to produce? It is necessary to determine the physical relationship between products. The following output relations can occur:

• Joint products - where the production of one product automatically generates the other e.g., wool and mutton
• Supplementary products - are obtained where the change in the production of one product has no effect on the production of another product. e.g., beef cattle and goats
• Complementary products - the increase in the production of one product also results in the increase of the production of the other e.g. (1) a combination of cattle and goats – goats prevent and control bush-encroachment, thus making more grazing available to the cattle or (2) the crop rotation with leguminous plants will lead to higher production.
• Antagonistic products - one product claims the 135
input of another product with adversely affects - e.g., cattle and blue wildebeest cannot graze together as the wildebeest is the carrier of the disease bovine malignant catarrh (Snotsiekte) that is fatal to cattle.

Van Zyl J (et all) expresses the rule for decision making as: Profit is maximised when two outputs or products are produced using a given number of limited inputs, where the physical rate of substitution of the two products is equal to the inverse price ratio of the products.

Evaluation of production processes

Many of you might have heard older people saying:" What worked for my dad is working for me". There is truth in the saying but you need to advance with technology, and you need to evaluate the production process.
To evaluate, is to measure. To evaluate the production process, you need to measure it against a standard or a benchmark. To make the correct and informed decisions you need to measure the budget vs. actual expenditures: marketing results vs. grading standards and marketing results vs. prices your products obtained - are products downgraded due to poor quality?

The marketing information will be discussed in the next section.

	Records	Reason why it is important
1	Activity records	To determine the costs (production cost) and where activities can be combined or reduced to save on input costs without compromising quality It will also assist with budgeting and eliminate unnecessary expenses.
2	Production records	Inputs used:- seed , fertiliser, pesticides, herbicides, implement costs, Planting dates , rainfall stats, irrigation scheduling, temperature This is important to plan for the next season and to correct mistakes, improve quality of work and to reduce unnecessary expenditure. The yield records can be incorporated with the land plan and soil samples to make predictions for the next season regarding cultivation, lime and fertiliser application
3	Soil samples	To be taken every 3 years - this will help to determine if there was an improvement or not and what the present status of the soil is Can the amount of fertiliser be reduced? Application quantities (fertiliser) may differ from area to area according to the soil analysis Marginal soil can be taken out of the production process and used for grazing.
4	Weed and pest control program	Crop rotation, use of herbicides and alternative crops can assist in reduction of weeds and pests - that will save costs Evaluate the effectiveness of the program used Use weather information before spraying to prevent the wash off of chemicals when it rain or with irrigation
5	Mechanisation program	Calculate the fuel consumption of the tractors used - to determine the fuel efficiency; with the high cost of fuel this becomes very necessary. Use cost comparisons from various sources to assist. Change cultivation methods where possible or necessary.

Several ratios can be used to determine the financial position of a farming business - the solvency, liquidity and profitability ratios.

To determine the production activities, a diagnostic analysis of the farming results need to be done. Various efficiency analyses can be applied, depending on the size of the farming business, the type of enterprise and the purpose of the analysis.

The following criteria or standards can be developed for the analysis:

- Criteria based on comparing the farm's records for year-to-year
- Average criteria for a region or area as obtained from study groups, cooperative services that assist farmers with data collection and interpretation and also the Department of Agriculture.
- Criteria based on the results of the top performers of the different groups in the region
- General accepted norms - in so far that these norms have been developed for and adjusted to suit the particular circumstances of the farming business.
- Criteria obtained from research results regarding physical and financial performances.

For this diagnostic purpose, the records of the farming business must contribute towards the development of evaluation criteria, and must be able to identify gaps in the production process. Deficiencies in a farming business are usually diagnosed by using efficiency criteria.

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General Criteria

This is criteria that are applicable to the farming business as a whole:

- Net farm income per hectare
- Net farm income per R 100.00 capital investment
- Gross margin for the farm business as a whole
- Return on total capital investment
- Gross margin per hectare
- Interest earnings on own capital
- Increase or decrease in the net value of the farming business.

Investment criteria This criterion takes into account the investment that was made in the farming business - what amount is invested in land, fixed improvements and livestock.

- Land value per ha
  - Value of improvements per ha
  - Total farm value per ha
  - Capital investment in livestock per large stock unit (LSU)
  - Value of livestock per hectare

- Machinery and equipment
  - Capital investment in power machinery
  - Capital invested in implements per hectare arable land
  - Capital investment in vehicles per ha

Utilisation of machinery

To determine the efficiency of machinery used, only the cost that is directly related to the cultivation - variable cost – are used

- ♥ Vehicle costs per hectare
- ♥ Power machinery costs per hectare cultivated land
- ♥ Tractor costs per litre fuel used
- ♥ Tons harvested per tractor
- ♥ Cultivation costs per unit harvested

Utilisation of labour

Only the direct locatable costs regarding labour can be used

- Labour cost per hectare (full time) per month
- Gross production value per R100 labour costs
- Net farm income per R100 labour costs
- Labour efficiency percentage - that is the total number of labour days worked by labourers as a percentage of the maximum number of available working days.
- Labourers per day per yield-unit harvested
- Hectares cultivated per labourer per day

Crop cultivation

Gross margin per hectare

Effective utilisation of cultivated land:

- Hectares cultivated per tractor unit
- Ratio of hectare cash crops to hectare fodder
- Cultivation costs per hectare arable surface area
- Yield per hectare harvested, per 100 mm rainfall or per irrigation cycle

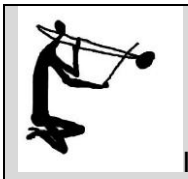
Measurement of practice

- ✓ Kilogram seed used per hectare
- ✓ Yield per hectare
- ✓ Fertiliser applied per ha
- ✓ Fertiliser cost per ha
- ✓ Cultivation cost per ha

The gross margin per hectare can be used for comparing the profitability of crop enterprises with each other, provided that production practices and fixed costs requirements are more or less the same.

THE USE OF MARKET INFORMATION TO ADJUST PROGRAM

Agricultural products are subjected to the market force of supply and demand. If there is an oversupply of a product on the market, the prices tend to be low. The opposite is also true; if there is an undersupply of a product the price is high due to the large demand. The producer must bear in mind that agricultural production is seasonal. It is therefore very important to use market information to have products on the market when the price is high.



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Other information obtained from marketing information

- Quality of the product. The cheapest way of adding value to your product is to ensure that it is of the best quality that you can produce. Ensure that the product is not bruised during the picking or harvesting process. Take care with the packaging and handling of products to (transport) and at the market (offloading) itself.
- The consumer might develop a different taste - it is necessary that the producer adjust to the new demand as quickly as possible.
- The classification standards can change - if the producer do not adapt he will not be able to sell his product.

The producer must form a partnership between him and his marketing agents to ensure that he obtain information and advice on what and when to produce. After you completed an analysis of the production process you need to make adjustments to the production process to ensure the profitability of the enterprise. The adjustments can be introduced immediately in enterprises where there is a constant production e.g., dairy or piggery. In other seasonal enterprises the changes will be made over time and the result of the change will in most cases only be seen at the end of the production season.

There are basically three changes that can be made

- Change the production process
- Change the products produced
- Close the production enterprise

Useful information for planning market related changes can be obtained from the RSA – food security bulletin on the web site of the National Department of Agriculture www.nda.gov.za

EVALUATION OF INFRASTRUCTURE

Production or on-farm production infrastructure

This will include all the facilities or infrastructures that will be needed for the production of the different commodities on the farm. The type of infrastructure will differ from farm to farm according to the

products produced, agro ecological region where the farm is situated, the topography of the farm and the financial position of the farmer and his/her personal choice.

Basic facilities need to be in place for the production of different commodities and as the quality and quantity of the product or production increases and with that, the quality of management, the facilities will also improve.

Crop / product	Infrastructure	Comments
Grain production	Lands, contours, water ways, Irrigation, pipe line and pumps , sprinklers Fences around the lands Access roads	Mechanical cultivation - Tractors , cultivation implements , Animal traction , draught animals with implements Hand cultivation with hand equipment
Fruit	Lands, contours, water ways, Irrigation, pipe line and pumps, sprinklers Fences around the lands Access roads Trellises Shade or hail netting	Mechanical cultivation - Tractors , cultivation implements , Animal traction , draught animals with implements Hand cultivation with hand equipment
Vegetables	Lands, contours, water ways, Irrigation , pipe line and pumps , sprinklers Fences around the lands Green houses or net houses Access roads	Mechanical cultivation - Tractors , cultivation implements , Animal traction , draught animals with implements Hand cultivation with hand equipment
Animal Production		
Dairy cattle	Milking shed or parlour, Feeding barn, storage barn Camps, feeding space, calf pens, handling facilities Milking machine, bulk cool tank	Roads for collecting milk Camp must be well drained to prevent build up of mud and dung
Beef cattle , Sheep and goats	Camps. Handling facilities Loading facilities In case of sheep - shearing shed / shed that can be used for this purpose If animals are grazing on irrigated pastures the irrigation will be additional	Fire breaks needed , water supply to different camps with water troughs Scale is necessary for performance testing – to measure growth
Game farming	Game fences, bomas to keep new game and equipment for the catching of game , water holes , Roads and water provision	If Game is used for hunting , accommodation for hunters, slaughtering facilities , transport Fire breaks
Poultry	Depending on the system used and the type of poultry - broiler house with equipment , Layers need cages or nest boxes in case of free range chickens	

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On-farm processing facilities

Where value is added to the product by means of sorting and packaging on the farm, provision must be made for the correct infrastructure. Products such as potatoes, tomatoes and onions are normally packed on the farm. After harvesting it is normally washed, sorted for size or damaged products and packed into the appropriated packaging. To be able to do this there must be washing facilities, sorting lines and

packaging facilities. Provision must also be made for the needs of the workers - ablution facilities and a place to eat. Most of the products are placed on pallets for easier handling. A Forklift is essential to assist with the loading of the pallets onto the vehicles that will transport it to the market.

Agro- processing

Where the products are not processed on the farm, the facilities must be available to transport it to the nearest processing or collection point. Roads play a vital role the transportation process, therefore the condition of the roads will affect the quality of the products - eliminate bruises. In the case of grain, care must be taken to reduce or prevent wastage or spillage.

Milk must be transported in cool tankers where the quality of the milk must be ensured; the temperature must remain cold enough to prevent bacteria from multiplying. Vegetables, flowers and fruit are also products that must be kept cold, and the cold chain must be maintained at all times.

Processing facilities can be a wide range of different facilities, from a silo to store the grain, a factory that cans vegetables or fruit, a pack house to store fruit and a milk processing plant\factory.

Other facilities that will play a role in the marketing of agricultural products are:

- Wholesale markets and trading centres
- Information and communication facilities
- Farm to market infrastructure

Regulations and legislation regarding natural sources and infrastructure:

A farming enterprise is evaluated according to certain regulations and legislations. Appropriate adjustments must be made and implemented to comply with these regulations and legislations.

There are several legislations that play a role in the provision of facilities and infra structure, depending on the type of product that is produced.

Soil conservation and the conservation of natural resources are also regulated by rules and regulations. These are necessary as it prevent the deterioration of natural resources and the negative effect that development may have on e.g., vlei-lands or any other sensitive area.

Animal health and safety act: - regulates Bio security, animal health and hygiene, the transportation of animals and animal products. Food Safety and Quality acts: - regulates the fresh produce markets to ensure that the produce is of the best possible quality - the municipalities will play a role with the marketing of fresh produce.

Hygiene is of crucial importance in sectors such as dairy, abattoirs or other on-farm processing facilities. Regulations, concerning the export of products to foreign countries such as Europe, the USA and U.K. are also in place.

Factors affecting infrastructure

The infrastructure on the farm will depend largely on the following:

- The type of product produced and the production process.
- The topography of the farm is playing a role in the design of the buildings, contours, waterways etc.
- The financial position of the farmer. Unfortunately, if the farmer is battling to make ends meet he/she will not spend money on infrastructure. Only when sufficient funds are available will he /she start to spend on improving the infrastructure.
- The history of the farming unit and its age will influence the state of development. Farmers, starting from scratch, may start with a development plan to get the facilities in place, as the development of the farm takes place over time and as funds are available.
- The needs of the products produced is also a determining factor

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Legislation that play a role in infrastructure

The following legislations are of importance regarding the infrastructure on a farm. Information of these acts can be obtained from the National Department of Agriculture (NDA) web page

- Soil conservation act
- Protection of livestock act
- Water legislation - can be found on the web site of the Department of water affairs and forestry – www.dwaf.gov.za
- Legislation such as the Groundwater resource assessment and management (GRAM) and NGIS regulations
- Legislation regarding hygiene at dairies, abattoirs and food processing plants:

ANIMAL PRODUCTS

PRODUCT	PUBLISHED	INDUSTRY DISPENSATIONS
Dairy and imitation dairy products	No. R. 2580 of 20 November 1987 No. R. 2581 of 20 November 1987 **Tables of Regulation 2581**	**17 July 2000**
Eggs	No. R. 25 of 8 January 1999 **English** **Afrikaans** **Tables**	
Ice cream	Draft document	
Meat	No. R.863 of 1 September 2006 **English** Afrikaans	
Mohair	No. R. 864 of 27 June 1997	
Poultry meat	No. R. 946 of 27 March 1992 **No. R. 988 of 25 July 1997**	

(Source: www.nda.gov.za)

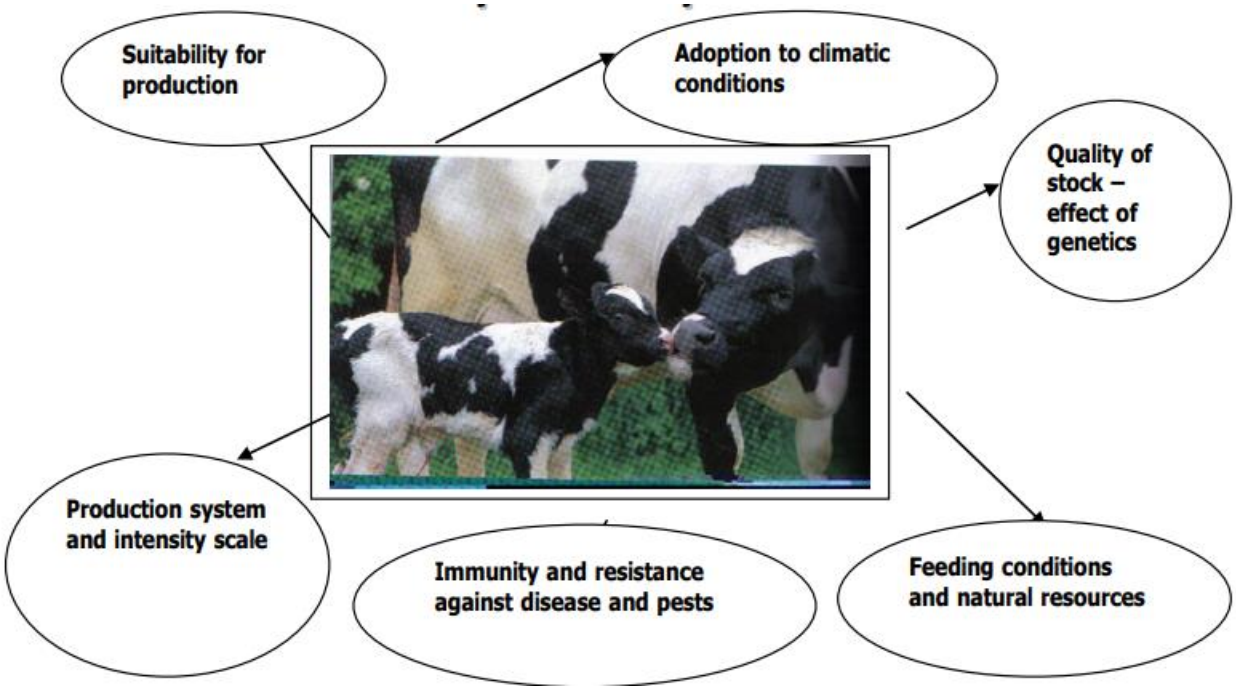
Provincial and municipal regulations regarding buildings and structures

Regulations regulating the transport of livestock

Export and quality regulations both local and overseas can also be obtained from the NDA website (Select the regulations applicable to your industry)

PRODUCTION STOCK

Deficiencies in production regarding stock are evaluated and adjusted to ensure optimum production



Livestock

The breeding stock or the production units used to produce the different products should be suitable for the purpose they are meant for. Stock showing deficiencies will have a negative effect on the production and productivity of the production unit The following deficiencies can influence the production process

	Deficiency	Influence on the production process
1	**Physical deficiencies**	
	- Feet , hooves and legs	Affects the ability of the animal to walk, stand and grazing. Foot rot and the cutting of hooves
	- Head and mouth	Skew mouth, undershot or overshot jaws, teeth - affects the ability of animals to eat, restrict animals to certain foodstuffs –worn teeth vs. grazing.
	- Back	Able to carry the body weight , reproduction
	- Mammary system	Especially with mammals where milk production is important for either production or raising of the young
	- Reproductive system	If the male animal experience problems with the reproduction system – no milk or calves
2	Genetic deficiencies	Breeding value - animal do not have outstanding genetic potential to breed pure and true to breed characteristics Production potential animal do not have genetic potential to produce quality and the required quantity of the product
3	Adaptation to environment	Climatic conditions – how do the animals deal with climatic conditions such as heat stress or extreme cold conditions? Animals in the warmer areas of the country and closer to the tropical areas can experience Tropic degeneration
4	Feed uptake and conversion	Feed conversion - Animals with low feed conversion ratios will need more feed to reach the target weight and will be less economical. Animals with a high feed conversion ratio will be more efficient in feedlots and intensive meat production systems. Some breeds are growing slow and mature too late.
5	Immunity against diseases and pests	Diseases caused by ticks - animals that are resistant to diseases, pests and parasites are easier to manage and at lower costs. The mortality ratio of theses animals are also lower.

To be able to evaluate the deficiency of animals the producer/farmer need to know:

- the breed characteristics of the animals he is using for production
- characteristics of functional efficient animals
- the ideal animal for the product produced

The characteristics and needs of livestock and crops are evaluated and adjustments to the enterprises are made accordingly.

Characteristic of livestock

To list all the animal breeds and characteristics in this space will not be possible. The learner should however concentrate on the animal breeds used in his or her industry and area. You cannot compare beef cattle with dairy animals. You also need to take into account the production system used - breeds used for extensive beef cattle production in the semi-arid areas of our country vs. breeds used for production in an intensive production area.

Crops

The same as for livestock, the producer need to select the crop and cultivar that will fit that area and farming circumstances best.

The wine maker use grapes from a specific cultivar to make a specific wine.

The maize farmers in different areas use different cultivars depending on the climate, heat units, length of the growth season, production potential of the soil, production system used and the purpose for production.

Plant breeders are constantly trying to find better cultivars or to improve on the existing cultivars. Genetic modified Organisms (GMO's) are in the news due to the consumer concerns. These cultivars changed plant production as a whole and are contributing to the cutting of production costs on the one side and increasing yield on the other side – thus improving income.

Characteristic of crops

The crop farmer must be able to evaluate the best crop for his purpose. The seed companies supply detailed information to enable the producer to make an informed decision. To be able to make the correct cultivar choice the producer must keep the following in mind:

- The production purpose
- The production aims – what does the producer aim to produce and the anticipated yield
- Soil conditions and topography
- Intensity of the production system – irrigation or dry land
- Disease and pest resistance
- Cultivation system
- Harvesting time and marketing

The producer must analyse his\her situation at first and then collect the production data and set production aims or goals. This must then be used as the starting point for the selection of the different cultivars to be planted. It is always a good policy not to put all the eggs in one basket - use more than one cultivar to spread the risk and ensure good end results.

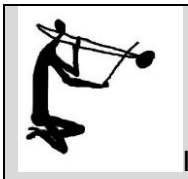
The producer should make use of a multi –discipline approach and put together a panel of experts that can advise him and his production team on the best possible solutions.

The suitability of resources for specific enterprises are evaluated and adjusted, and appropriate changes are implemented

The decision to produce a certain crop on a certain farm or production unit should be an informed decision and not an instinctive, spur of the moment decision because other farmers or producers in the same area did so well and made so much money.

When a production decision is made, the producer must evaluate the following criteria:

- Is there a market for the product that I want to produce and what are the market requirements?
- What soil conditions\type is needed for the product?
- Climatic conditions – heat and cold, wind and hail?
- Need of water - are there sufficient water resources available?
- Distance from the market and facilities needed?
- Infrastructure – availability and provision costs?
- Cost to change machinery and equipment to suite the new production system or enterprise?
- Transition time – how much time is needed and how much time available?



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Considering these factors, time-consuming and costly, do you still want to make a change from one production enterprise to another? The producer must make sure that he evaluate all the different possibilities and evaluate the different scenarios, before he makes a final decision.

The production must be sustainable over the long term and the producer must be given the opportunity to grow into the production of the different products. The different pitfalls can only be eliminated and avoided by means of experience. The best will be to start changing step-by-step and develop the new production process over time.

HARVESTING PROCEDURES

Harvesting

Harvesting is the process of gathering the matured products from the fields with the purpose of selling it or use it for own consumption.

Harvesting marks the end of the growth season for that particular crop – maize, fruit, veggies, hay, etc. It is a very important time on the farming calendar as all time and energy is focused on removing the product from the field\orchard\land as fast as possible to ensure good quality produce and to prevent deterioration – especially fruit and veggies – by the time it reaches the market.

Criteria for harvesting

Harvesting can only start when the crop or product is at the correct physiological stage – fruit must have the correct size, colour and sugar content whilst grain must be dry.

In the case of animals, "harvesting" of milk and eggs takes place on a daily basis. Products such as mohair, wool and feathers are "harvested" once or twice a year. Meat products are "harvested" when an animal is slaughtered.

Adjustments and implementation

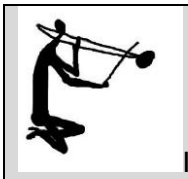
Various methods are used during the harvesting process:

Product	Harvesting method	Equipment used
Winter Grain - wheat, oats, barley	Mechanical harvesting	Combine harvester- self propelled or tractor driven.
Summer grains – maize, sorghum, sunflower	Mechanical harvesting	Combine harvester- self propelled or tractor driven.
Fruit	Hand picking	Picking baskets and trailers for transport
Grapes – wine	Hand and Machine picking	Picking baskets and grape harvester
Nuts	Picking it from the floor/ ground	Containers to collect
Vegetables	Hand picking	Wash and sort
Carrots, potatoes, onions	Mechanical or labourers - harvesting from the ground.	Harvester, bags or crates, bins, transport to pack houses – processing, washing and sorting equipment
Beans and peas	Mechanical Harvesting	Harvester, transport, bulk handling.
Fodder products	Mechanical - cutting, raking and baling or ensiling.	Mower/conditioner rake, baler, transport, bale loader storage facilities
Animal Products		
Milk	Milking machines + labour	Bulk tank, transport, pumps, washing equipment,
Eggs	Collection by hand	Sorting, packaging
Meat products	Transported to an abattoir to be slaughtered	Transport to abattoir, transport of carcass, processing and storage facilities

The following factors will determine the equipment used for harvesting:

- The type of product produced. Different equipment is used for different crops and products

- The volume of a product to be harvested. Grain products –e.g., maize fields cover great areas – will mainly be mechanically harvested. Using expensive and sophisticated farm machinery such as combine harvesters saves time and will be more cost effective.
- The weather conditions. If the weather is not favourable for harvesting or only allow a short harvesting period, it will be worthwhile to make use of contractors or machinery to assist and get the harvest done in as short time as possible to ensure a quality product.
- •The market situation. Producers always aim for the highest or best price for their products. These prices are determined by 'supply and demand'. It is therefore important for the producer to 'read' the market – he must either be early with his products or hold back (if possible) to supply in time of shortages. (The producer must at some stage get hold of extra labour or equipment to enable him\her to be early on the market.)
- The level of intensification. The more intensive the farming operation, the more sophisticated the harvesting equipment will be to ensure that a product of very high quality is produced
- The type of product. Fresh produce - at the correct physiological stage - must be harvested in a short time span and reach the market quickly to ensure good quality.



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Evaluation of harvesting practices and adjustments

The producer must evaluate the harvesting process to determine the following;

- Quality of the harvest – wastage, breaking of grain, damaging of the product.
- Speed or duration of the process
- Handling of the products
- Grading and sorting ♥ Alternative methods
- Quality of the product

Health and hygiene regulations and legislation

Various crops and animal products are produced on farms. The quality of these products is regulated by regulations. This is necessary to protect the consumer and to ensure that the products meet the set standards.

The Directorate food safety and quality amends these regulations from time to time and it is their function to ensure that the regulations are applied and that the products comply with these regulations.

Products earmarked for export must also comply with a set of rules provided by the European Parliament. These strict regulations are applicable, not only to the hygiene of export products, but to the facilities where the products where processed or produced as well. These regulations can also be obtained from the NDA web site or from your local extension officer.

Product evaluation quality control

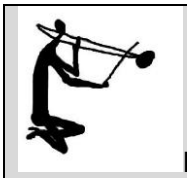
It is the function of the farmer to supply the market with products that are clean, hygienic and of good quality. The quality of the product will determine the price and it will also lead to consumer satisfaction.

It is very important that the producer is aware of the consumer's and market's preferences. If products that do not meet with the requirements of the consumers, it will result in wastage – a loss in income! The same money, time, labour, etc. is needed to produce an inferior product vs. a quality product – the only difference will be the income on the market.

The farmer\management is thus forced by regulations – domestic and export - as well as the consumers to produce quality products.

Various processes of quality control should be in place to ensure the best quality products.

- ✓ Production process – during the production process the manager, in his\her section, must enforce quality control at all times to ensure that the end product is not degraded due to machines not functioning well.
- ✓ On farm processing – during the processing on the farm quality control must be in place to ensure that only the best quality is processed and packed for the market
- ✓ At the farm gate – the last on farm quality control should be at the last point to ensure the products are loaded correctly, handled correctly and that the transport will not affect the product
- ✓ Market control – The market agents are also obligated, to some extent, to do quality control before a product is sold. It is therefore important that the farmer communicates with the market agents to obtain information that can aid with the improvement of quality.
- ✓ Local authorities (municipalities) appoint their own inspectors to ensure that products comply with regulations.
- ✓ The Department of Health is responsible to ensure that hygiene at dairies, abattoirs and other processing facilities are adhered to. Facilities must be approved and certified on a regular basis .The Directorate Food Safety and other similar bodies are responsible for quality standards at supermarkets and other sales points.
- ✓ Appointed agencies are responsible for the inspection and certifying of export products to ensure these meet and comply with requirements of importing country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POST HARVESTING PRACTICES

Post-harvesting practices - crops

Post harvesting technology is described as "all the complex operations supported by biotechnologies that are resorted to, to ensure the optimal conservation of crops during and after harvest and throughout all the stages of handling, storage, packaging, processing and distribution."

Post harvesting constitutes the end of the harvesting operation and this is the last stage before the product reaches the consumer.

A number of aspects need to be addressed:

- Stage of harvesting
- Handling during harvesting
- Transportation
- Sorting, grading, washing
- Packaging
- Treatments
- Distribution to market


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This is done to ensure that the consumers receive a product that will provide value for their money. Most of the vegetables and fruit, being perishable products, deteriorate because of a shorten shelf life caused by…….

- wrong physiological stage at picking, wrong cultivar choice or variety, poor cultivation practice and pest control
- not handling it properly at harvesting or during transportation
- heat or cold treatment and storage
- Washing or wrong treatment
- Poor packaging and transportation

Stage of harvesting

The point of harvesting is determined by the physiological stage of the crop or fruit. It can be measures in Brix or the sugar content of the fruit. A cultivar with a long shelve life will simplify the storage problem.

Handling during harvesting

It is important that the product does not come in contact with soil during the harvesting process as soil contamination will contribute to the product's (bad) appearance – thus, make use of picking bags\containers designed for this purpose. It is advisable to harvest early in the morning as the shelf live of withered veggies is shortened. A range of different treatments are needed to prevent deterioration after harvesting.

Transportation

Transportation from the land to the sorting facilities also plays a role in the product's quality and appearance – thus, the stacking of the bags\containers on each other must be done in such a way that bruising and rubbing is prevented. Transportation to the market is done in cooler (temperature controlled) trucks as a certain temperature must be maintained.

Sorting, grading, washing

The pre-preparation of farm produce is very important – the moment a product reached the market, the farmer has no control on the selling price and will rely on the product selling itself. The product must therefore be graded – e.g., same appearance, acidity, and firmness; sorted – e.g., same size, Brix and colour. It is not uncommon for a product to undergo further grading – distributors preparing it for large chains stores or supermarkets.

Washing – especially potatoes – is equally important and done before the sorting process commences. Some produce is washed in treated water, not for the cleaning as such, but to prevent bacteriological deterioration and decay.

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Packaging

Packaging – for export - is done in cardboard boxes with absorption layers between the products. For the local market packaging is done in plastic or paper bags, depending on the type of product and the market it is intended for. According to regulations – for local and overseas market -the packaging must display information regarding the producer for tractability of the product.

Treatments Produce undergoes treatment in regulated storage where the atmosphere is modified or controlled, ultra-low oxygen storage, oxygen and ethylene adsorption is done to prolong the shelf life of the products

Post harvesting - animal products

Meat producing farm animals are bred and fed on the farm. This includes the post harvesting process which entails dosage – especially piglets –castration – male lambs - dehorning etc. Although large enterprises (meat) are equipped with abattoirs, the norm is to sell the produce to butchers or feed lots. Cattle are dehorned to prevent injuries during transportation.

Other animal products can be divided into:

Fresh products or perishable products	Non-perishable products
Milk	Wool
Eggs	Mohair
Meat	
Hides	

Milk

Milk must be cooled down to 5°C as soon as possible and be kept at that temperature during transportation and distribution. Post harvesting treatment of milk involves cooling, pasteurisation and in some cases homogenisation.
Apart from daily fresh milk usage, it is also used for making cheese, yoghurt, umkumasi, milk powder and long-life milk.

Eggs

Eggs are stored in rooms where the temperature is lower than room temperature. Eggs are sorted according to size and weight and packed in egg containers – 1 dozen, 2.5 dozen or 5 dozen (so-called taxi packs) and in 30 dozen boxes when transported to different distribution points.

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Wool and mohair

After shearing wool is graded in classes according to the length, strength and thickness, measured in micron. The different classes are then baled (pressed) jutebags which are properly marked and identified for trace ability before it is send down to the different wool markets.

It is very important for the producer to ensure the product is correctly classed to prevent penalties. The producer should also ensure that there is no contamination of the product with foreign materials such as plastic, baling twine or plant (weed) seeds.

Post harvesting practices are evaluated and adjusted where necessary

There are various organisations, locally or international, that set standards for the different products. The following organisations are involved in the setting of standards:

	Product	**Standards**
1	Maize	S.A. Grain
2	Wheat	Milling industry
3	Milk	Dairy standards – Milk Distributors
4	Meat	Meat producers organisation and the department of Agriculture
5	Oranges	EurepGap, Euro-Retailer, Produce Working group and Good Agricultural Practices British Retail Consortium (BRC) USDA Products, production process and Equipment certification
6	Fruit	EurepGap, Euro-Retailer, Produce Working group and Good Agricultural Practices British Retail Consortium (BRC) USDA Products, production process and Equipment certification
7	Vegetables	National Fresh product markets and National Department of Agriculture

The aim is to ensure better quality product, reduce losses and obtain higher prices and higher net returns and continuous access to the markets.

The producers are normally held responsible for the quality of the product from the production point to the delivery at the market. When the product is collected on the farm or where the product is delivered to the workstation of co-operative packing facility, it becomes a shared responsibility.

Good health and hygiene principles

Hygiene is very important when working with fresh produce or perishable products. The hygiene can be divided into different categories:

Hygiene	Description
Working environment	The area where the product is handled as well as the equipment used in the harvesting or post harvesting process must be hygienic clean to prevent contamination of the product and prolong the shelf life of the product
Workers	Measures must be taken to ensure that workers follow hygiene protocols and that they are aware of what is expected from them and why the process must be hygienic.
Product	The product must be clean and satisfy the minimum requirements laid down for quality products.

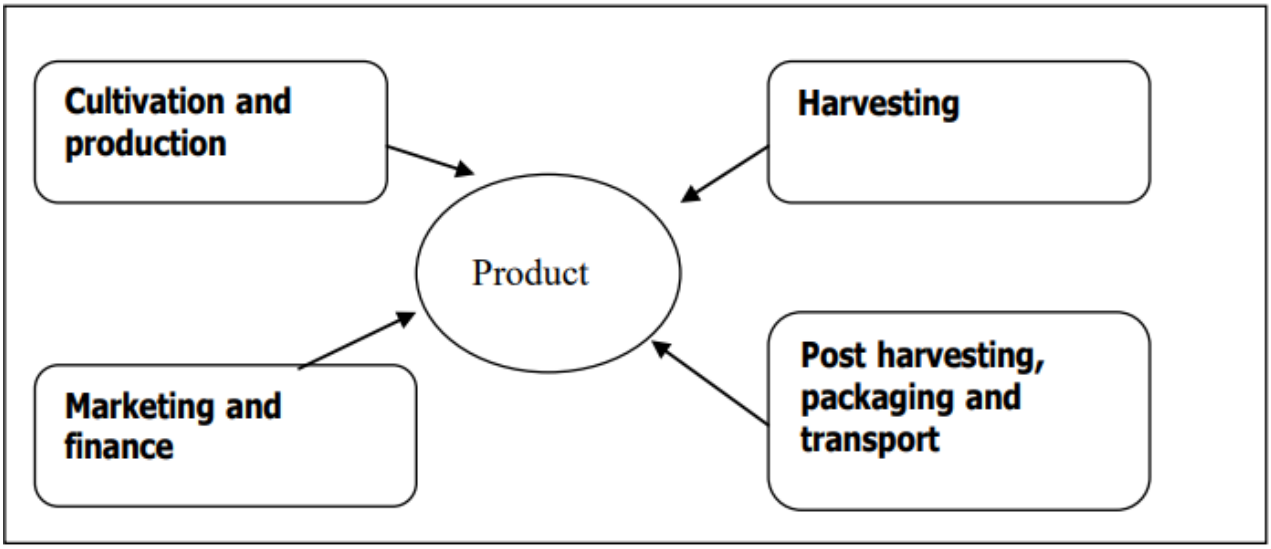
To evaluate the hygiene, quality and post-harvest practices the producer should do the following.

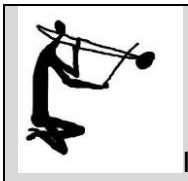
1. Draw up a check list to evaluate the different processes and stages of post harvesting activities. The checklist should be used to promote responsibility, accountability, eliminate problems and to measure work performance.
2. Keep records of production, classifications, and damaged products. Find ways to reduce the damaged products, thus improving the percentage packed.
3. Keep records of the different classes (%) that was attained from each cultivar or from each land. Draw graphs to illustrate the records.
4. Important to keep records of the selling prices from the different markets for the different products as well as discarded produce. Determine the cause to be able to take precautionary steps during the next season.

Health and hygiene regulations and legislations are reviewed, and changes are integrated into the procedures. The farmer (management) and downwards to the lowest levels of workers must know these regulations and legislation regarding the products that are handled. Incentives should be linked to the marketable percentage (%) of the crop and the prices received for the quality products.

The whole production team must take responsibility for the product as every section contributes to the success of the product. It is a team effort and should be seen as a holistic process that cannot be fragmented as each one plays a very specific role and must be involved in the production process to understand the importance of his\her action.

An illustration of the different role players in the production process;





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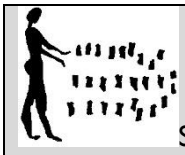
Products are evaluated and quality standards are adjusted accordingly

The producer must always be responsive to changes and market tendencies to improve either the quality and quantity or cultivar. The producer that lags behind will not achieve success unless changes are made in good time.

It is therefore important that an in-depth evaluation is made regarding the whole production cycle – cultivation; pest, weed and disease control; pre-harvesting processes; harvesting methods; sorting or grading; packaging; cost and profitability – either for cutting costs or to please consumers. Market information is a crucial source of information.

The question that needs to be asked is - how can we improve on what we did? What steps can be taken to produce a better product?

The answers to these questions will ensure that production is sustainable and that everyone involved in the production process will benefit by it!



SUMMATIVE 1

Unit 2: Sustainable Agriculture

Unit Standard		
116288	Execute sustainable resource use and quality control	
Specific Outcomes		
SO 1: Determine availability of resources and maintain sustainable resource use. SO 2: Determine the scope of the enterprise / production unit. SO 3: Apply the principles of quality management systems. SO 4: Integrate the concept of quality control into the production process.		
CCFO's		
Identifying Working Organise	Communicating Demonstrating Collecting	Contributing Science

REVIEW

Different Levels of Planning

- The level of planning is determined by the level of goal setting.
- Reaching strategic goals requires strategic planning, reaching production goals requires a production plan, and reaching pest and disease control goals requires a pest and disease control plan.
- Product selection depends mostly on environmental factors (climate, soil, water availability, etc.) and on market opportunities.
- Planning has to be flexible, allowing changing circumstances to guide their relevance and validity.
- A budget is a financial expression of a plan.
- Income is money generated from the sale of a product.
- Expenditure is the cost associated with generating income.
- Costing means determining the actual cost of producing a specific product or delivering a specific service.

Scheduling

- Scheduling is about putting plans to a timeframe.
- Scheduling indicates who will perform the work, where will the work be performed, what resources are required, how progress will be measured against the scheduled work, and how progress will be reported on
- Scheduling techniques are tools used to facilitate the scheduling process.
- The most commonly used scheduling techniques are flow, milestone, CPM, PERT and Gantt charts.
- Schedules can be created forwards, meaning from a certain date onwards with an estimated completion date, or backwards, meaning from a predetermined completion date back to the date on which the task will begin.
- Schedules must be displayed prominently and communicated well.

Production Optimisation Techniques

- Production optimisation techniques are about making accurate, early prediction relating to the crop, and manipulating the tree and its environment to produce the best possible quality and quantity crop.
- Decisions on production interventions are made on the basis of accurate information, which is obtained from records.
- Records must be kept of inputs made and their costs.
- Output records that must be kept include yield and fruit size distribution, percentage to each market segment, cull factor analysis, maturity indexing data, and actual versus budgeted income.
- Statistical analysis is used to evaluate the validity or significance of the results from data collected, and to determine the extent to which two variables are proportional or linearly related to each other.
- The steps required to manage a production unit are:

- Decide the objective or goal.
- Set the required standards.
- Decide on the implementation plan.
- Schedule the activities.
- Allocate responsibilities and resources, or inputs.
- Measure progress and results.
- Evaluate by comparing the results with the goals and targets set.
- Adapt the goals and/or targets.
- Adapt the inputs, and go back to step 5.

Assessing Planning and Scheduling

♥ Production activities are varied, often overlap, and should follow a logical sequence.

♥ Goal setting is followed by planning, which is followed by scheduling, which is followed by implementation, of which records are kept, which are used to evaluate the implementation of the plan and the achievement of the goals, which allows for optimisation.

Definitions

Budgeting :	Budgeting is the process that provides a detailed breakdown of what is planned to be spent and earned for each item of income and expenditure by month for the financial year.
Income :	Income is money generated from the sale of the product and may include other minor sources, such as interest received.
Expenditure :	Expenditure is the cost associated with generating the income and supporting the business over the longer term.
Costing :	Costing is a process for determining the actual cost of producing a particular product or providing a particular service.

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MAINTAIN SUSTAINABLE RESOURCE USE

Introduction

In previous unit standards, we defined **planning**, identified some of the different levels of planning, and considered the factors influencing planning. We also defined **resources** and made the distinction between fixed, or natural, resources and mobile resources.

We have also seen that resources and inputs are similar, though resources are generally viewed as start-up requirements, while inputs usually refer to ongoing operational requirements.

In this section we bring together these concepts to assess the status and availability of resources for a production operation as the first step of using resources in a responsible and sustainable manner.

Resource planning

Assume that the decision has been made to produce a certain crop for the first time, or to expand existing plantings or production.

The first question should be: Is there a market opportunity for the crop/animal product? Let us assume that the results of the market study are positive.

The second question is: Do I have the necessary resources to produce what the market wants? To answer this question, an inventory needs to be made of the quantity and quality of the resources and inputs that are available, compared to what is required for the production of specific cultivars/ animals. One can then determine whether it makes financial and practical sense to undertake the enterprise.

An inventory of this kind would include the following:

- Climatic Features
- Land
- Soil
- Water
- Plant material/ Animal breeds
- Capital
- Labour
- Agrochemicals/ veterinary medication
- Machinery and equipment

Climatic Features

Climate is viewed as a resource in the sense that temperature, humidity and sunshine are vital contributors to the productivity of the trees/ livestock and the marketability of the product. They are factors characteristic of a region or area that determine the suitability of that location for the purpose of high-quality production.

If produced in an unsuitable or marginal climate no selected agricultural commodity will be able to give a proper yield. The greater the need to manipulate or intervene, the more the long-term sustainability of production in that location is threatened, the greater the impact on the environment, and the higher the production costs.

The questions that need to be answered are the following:

- What are the long-term average monthly maximum and minimum temperatures of the area?
- When converted into heat units, how do these compare with other areas known to be suitable for the selected range of cultivars/breeds?
- Or conversely, what is the range of cultivars/ livestock breeds that could be produced given the climatic profile of the area?
- What are the dominant prevailing wind directions and strengths? Are windbreaks necessary and, if so, can they be accommodated?
- Will the climatic conditions, such as high temperatures and humidity, increase pest and disease pressure?

Factors limiting production in some areas are:

- High spring/summer temperatures.
- Low relative humidity.
- Water stress during critical growth periods due to poor availability.
- Hail.
- Wind, which causes external blemishing.

Factors limiting livestock production in some areas are:

- Low rainfall and therefore low-quality grazing
- Extreme temperatures

Of these, temperature is the most important factor. It is however difficult to separate the influence of temperature from that of other factors.

Land

Apart from the availability and cost of land, the following questions need to be answered regarding the qualities of the land:

- Is it sufficient in size and topography to support the required production units?
- Can the majority of tree rows be planted in the ideal north/south orientation?

- ♥ Does the orientation of the land create microclimates to favour the production of certain cultivars or cultivar selections?
- ♥ Is the land located near to suitable transport infrastructure?
- ♥ Is there adequate grazing and drinking water for livestock?

Soil

Generally speaking, crops require well-drained, deep, sandy loam soils with clay content of below 30% and a neutral pH. The chemical and physical properties of the soil should be analysed before a decision is taken to establish the crop. By deep ripping and ridging, some marginal soils can be made more suitable. Although these actions will increase costs, they can also be of use in crop manipulation, such as for heating soil in cold climates.

Where livestock production is selected, the most important factor will again be the amount of rainfall. If livestock are kept on clay soils it must be regularly ripped in order to prevent the surface from compacting and forming an impenetrable surface for water etc.

Water

The peak water requirement of the envisaged planting must be calculated and compared with the available water resource. As a rule of thumb, provision should be made for between 50 litres per adult tree per day for high-density plantings (>1000 trees / hectare) and 100 litres per adult tree per day for widely spaced trees (<600 trees / hectare). Allowances should be made for evaporation if holding dams are to be used.

The water source should also be analysed to determine its chemical quality and the presence of any harmful fungal diseases.

The amount of water an animal requires per day may be as high as 80 litres per day for cattle and 3.5 litres for sheep and goats especially if summer temperatures are high. The quality of water has a direct influence on the quality and quantity of production of beef and other animal products.

Availability of planting material

Growers must remember that the material they will be planting must be of a high quality to ensure the expected yield. This is envisaged even more when fruit trees and vines are planted which have to produce for up to 20 years and more. Fruit trees and vines may take up to 4 years before they come into full production.

When selecting a breed or new stud animals a stock farmer must always focus on the most important physical contributions of animals to ensure the best possible offspring. The stud registers of these animals must be studied in order to ensure that the animal is able to produce the desired product.

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Capital

The cost of capital can be viewed as the annual interest payment on the sum required. A business plan is required, which set out the marketing plan, the production objectives and the capital required to fund the establishment and operation of the farming unit. Here, the cash flow projection is critical and should be based on conservative prices and constantly rising costs.

Capital can be borrowed from a number of financial institutions. The interest rates and repayment terms that are negotiated with the financial institution have a great impact of the viability and sustainability of the farming enterprise.

Labour

There must be a source of permanent and temporary labour available in the area. Experienced and skilled permanent workers bring a competitive advantage to a farming enterprise. Many farmers also continue to develop the skills of their permanent workforce through ongoing capacity building programs.

The industry average for fieldworkers are said to be one worker for every five hectares. In addition, lower, middle and upper management personnel are also employed, with the management structure and number of positions depending on the size of the farming enterprise, and the farming practices.

Harvesting and packing are highly labour-intensive activities, during which temporary workers are employed. The number of temporary workers required depends on the total crop yield and the time available for picking and packing.

Agrochemicals

Agrochemicals includes ameliorates for soil preparation, fertilisers and crop protection, and post-harvest chemicals.

The types and quantities of agrochemicals that are required depend on the size of the production operation and the farming practices that are employed. Agrochemicals are purchased from reputable firms or from farmer cooperatives.

Machinery and Equipment

Machinery and equipment that are used on citrus farms include:

- Tractors.
- Spray machines, also referred to as mist-blowers.
- Herbicide carts.
- Flatbed and picking trailers.
- Grass slashers.
- Water carts.
- Harvesting equipment, including ladders, clippers and picking bags.
- Planting equipment, including measuring equipment and spades.

- Soil preparation equipment, including rippers.
- Maintenance tools and equipment.
- Veterinary equipment.
- Equipment used to handle livestock.

The type and quantities of equipment that is required depend on the size of the farming operation and the farming practices that are employed.

Machinery, equipment and tools are purchased from reputable suppliers or from a farmer cooperative. It is important to purchase machinery and equipment, especially large and expensive machinery such as tractors and spray machines, from dependable dealers in the area where the farm is located, because after-sale service plays an important role in how effectively the machinery can be used.

SUSTAINABLE USAGE OF RESOURCES

The sustainable usage of resources means the use of the resources in such a way as not to damage, harm or deplete them. The important principle underpinning this is minimum intervention.

If production enterprises are established in an unsuitable environment or with soils, water or material of inferior quality, there will be an ongoing need for interventions of various kinds. Such interventions are not only costly, and therefore threatening to the profitability of the enterprise, but may require the repeated use of chemical treatments which can start a spiralling cycle of damage to the environment.

For example:

- If the climatic conditions in the area do not favour the production of good yields of high quality fruit of the chosen cultivars, the production manager will face an ongoing battle to attain the required standards by crop manipulation. Such manipulation may take the form of physical treatments such as trunk girdling or pruning, or chemical treatments such as hormone or supplementary nutritional sprays.
- If the pH of the soil is too high or too low, corrective action, in the form of applications of certain chemical formulations, has to be taken on a regular basis.
- If the nursery trees are of inferior horticultural quality, the production of high yields may require ongoing physical and chemical manipulation, or may not even be achievable whatever interventions are made.
- If the trees become infected with fungal, bacterial or viral diseases, there may be a requirement for regular chemical or physical disease control actions. Such diseases may have their origin in the nursery trees, be endemic to the production area, or be induced by poor management practices.

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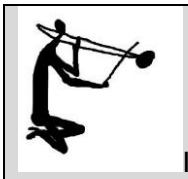
For example:

- ♥ The sustainable use of veld to ensure grazing is maintained and the consistency of plant species is maintained.



Individual Formative 1

To ensure grazing for future generations and to maintain sufficient feed of the correct quality for animals, to provide for their own health and to produce a quality product.

The correct grazing / veld management principles listed below must be implemented:

1. The correct load capacity of animals for the area farmed on must be selected. (the number of animals kept on an area that would not overgraze the area).
2. Plant succession principles must be implemented to improve the veld consistency by increasing the number of climax species and decreasing at the same time, the number of pioneer species.
3. Good rotation grazing practices must also be implemented. Dividing an area into different camps or paddocks with wire fences and regularly moving livestock to prevent overgrazing can do this.

Water is one of the scarcest resources and the use of water must be managed and controlled very carefully to ensure its sustainability. In order to preserve the supply of water the irrigation system should be effective and efficient. In water scarce countries, such as Israel, important pioneering work was done in the design of micro-sprinkler and drip irrigation systems to optimise water use efficiency. Such systems form the basis of sustainable water usage in fruit production.

Water quality must also be maintained to ensure that the available water remains useful. Every farmer has the responsibility to ensure that the water that leaves the farm is of the same quality as the water that is received on the farm. Regular sampling and analysis is required to ensure that the water quality remains acceptable.

Agrochemicals pose a direct threat to the environment. If certain broad-spectrum pest control treatments are used, they may damage the populations of beneficial insects. Pesticides must be chosen carefully on the basis of their specific impact on the targeted pest and their minimal disruption to beneficial insect populations.

The production plan

The production plan ranks alongside the marketing plan and financial plan as major contributors to the overall strategic plan of the enterprise. These plans form the basis of the business plan that demonstrates how the different facets of the enterprise are linked in achieving targeted revenue and profits, and sustainable cash flow.

The production plan comprises a number of component sub-plans, each with their own objectives and timeframes. These would include, for example, individual orchard yield plans or projections, pest and disease control plans, the fertiliser and irrigation application plan and so on.

In this section we focus on the production plan itself, which represents the combined outcome of all the sub-plans referred to above.

At the heart of the production plan is the production or yield model. This takes into account cultivar, rootstock, tree spacing, climate, soils, irrigation, and pest and disease factors.

The yield model in fact takes into account the role of all resources and inputs, together with observation that are made in the orchard, to project the year-on-year yield for the lifespan of the specific planting. The sum of the yield models for each cultivar gives the production model for the entire farm or enterprise.

EXAMPLE:

An entrepreneur decides to establish citrus for fresh fruit export on a 100ha farm located in the Mpumalanga Lowveld.
Having conducted an evaluation of the market potential for cultivars known to be suited to the region, he takes stock of his resources.

- He evaluates the location of the farm and its topography in terms of its suitability for citrus and conducts a soil survey and determines the availability of water.
- He investigates the availability of labour and identifies a source of certified nursery trees and conducts a risk analysis of the pests and diseases in the region.
- He determines his labour requirements and ensures that there is enough skilled labour available in the area.
- He determines his agro-chemical and machinery and equipment requirements and identifies reputable suppliers in the area.
- He then uses all this information, add factors such as rootstock, planting distances, etc., and determines a production or yield model for each citrus variety he intends planting. For the sake of simplicity, he decided to plant only two varieties, grapefruit and Valencia oranges, of which he intends planting 50ha each. The production or yield model for these inputs could look something like the table below for the first sixteen years of the respective plantings' life spans, with the total yield calculated by multiplying the yield per hectare with the number of hectares.

Years After Planting	***Yield / Hectare*** (Metric Tonnes)	***Total Yield*** (Metric Tonnes)

	Oranges	Grapefruit	Oranges (50ha)	Grapefruit (50ha)	Total
1	0	0	0	0	**0**
2	12	0	600	0	**600**
3	29	5	1,450	250	**1,700**
4	45	17	2,250	850	**3,100**
5	52	24	2,600	1,200	**3,800**
6	57	33	2,850	1,650	**4,500**
7	63	40	3,150	2,000	**5,150**
8	67	46	3,350	2,300	**5,650**
9	67	51	3,350	2,550	**5,900**
10	67	54	3,350	2,700	**6,050**
11	67	58	3,350	2,900	**6,250**
12	67	59	3,350	2,950	**6,300**
13	60	60	3,000	3,000	**6,000**
14	55	60	2,750	3,000	**5,750**
15	53	60	2,650	3,000	**5,650**
16	47	60	2,350	3,000	**5,350**

A figure for the estimated percentage of exportable fruit can be factored into the yield model to calculate the amount of fruit available for export each year. Fruit size ranges could similarly be introduced into the model. A price projection can now be done based on historical data. With projected export percentages for class 1 and class 2 fruit, and projected size ranges, prices per size range and per class can be projected and the total projected income can be calculated.

This information would then be used as the basis for determining the extent to which estimated production will meet projected demand. This could in turn be used for planning pack house capacity and as the basis for compiling financial and business plans for the enterprise.

The production practices that are required to achieve the projected production can now be formulated. It may for instance be found that in order to produce fruit in the size range that is most profitable in the market that is targeted by the producer, specific irrigation and fertilisation practices are required. Once the production practices have been determined, the labour requirements to implement the planned practices can be calculated.

The production plan for the enterprise is now in place and can be implemented, managed and monitored.

The production plan can now also be used as a basis for developing a business plan for the enterprise. The cost of the planned production practices and projected labour requirements can be calculated and the capital requirements, profitability and cash flow of the enterprise can be calculated.

EXAMPLE:

An example of a production plan for animals.

The following questions must be asked before the farmer starts his animal production enterprise:

1. Availability of capital.
2. Projected profit analysis.
3. Suitable species selection
    - Compatibility of the species to the specific area selected.
    - Consumer Market preferences.
4. Experience of a manager in the specific field of production.
5. Availability of natural resources.

Implementation Plan:

- All necessary infrastructure, water delivery systems, fencing, housing, etc. must be in place.
- Production units must be put in place, for example; sheep, cattle, goats, ostriches, chickens, etc.
- Implement management plan including:-
    - Health maintenance; rotation practices;
    - Breeding and harvesting seasons; and
- Marketing plan, including product selection and network planning.

Legal requirements

The employment of resources to support the production plan has to be compliant with legislative requirements. These legal requirements that are promulgated as acts of parliament effectively place boundaries on the various production and marketing activities and how they are conducted.

The production manager should be aware of the key requirements of these and other relevant pieces of legislation when planning his citrus production enterprise. Compliance with the requirements may involve costs that have to be factored into the plan.

The following are examples of some of the activities and the related Acts:

- **Conservation of the environment** – Conservation of Agricultural Resources Act of 1983 and National Environmental Management Act of 1998, Plant ement Act. Improv.
- **The minimum citrus fruit quality standards for local and export products** – Agricultural Products Standards Act of 1990.
- **Health and safety and good agricultural practices** – Health Act of 1977, Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act of 1947, Agricultural Pests Act 1983, Occupational Health and Safety Act.

- **Marketing of citrus** – Marketing of Agricultural Products Act (Amended) of 2001, Agricultural Produce Agents Act.
- **Equity and fair labour practices** – Employment Equity Act of 1998, Basic Conditions of Employment Act, The Land Reform Act (Labour Tenants) of 1996.

Meat Safety Act To provide for measures to promote meat safety and the safety of animal products; to establish and maintain essential national standards in respect of abattoirs; to regulate the importation and exportation of meat; to establish meat safety schemes; and to provide for matters connected therewith.

Individual Formative 2

SCOPE OF ENTERPRISE / PRODUCTION UNIT

Economies of scale

Definition: ***Economy of scale:*** Economy of Scale simply means that, theoretically, as one produces more, the cost per unit produced decreases.

In production, economies of scale means that as an enterprise grows and the number of tons produce produced increases; the enterprise would have a chance to decrease the cost of producing each ton of produce. The same would apply to a pack house operation or any activity involving inputs and outputs.

Economies of scale are achieved through:

- Buying inputs in bulk, such as fertiliser, pesticides or nursery trees/ livestock.
- Spreading the cost of expensive inputs, such as specialised staff and technical specialists, over an increasingly number of tons produced.
- The application of better and more efficient organisational skills and structures.
-

Just like there are economies of scale (ES), there are also diseconomies of scale (DS) (*R. Heakel, Investopedia*). This occurs when management inefficiencies result in rising average costs and production is not able to keep pace with the proportional increase in inputs. Inefficient management of labour can, for example, lead to the employment of additional staff whose output is not necessarily higher than it was with a smaller staff number.

There are also external economies of scale. These occur outside of the enterprise itself within the industry, for example using collective bargaining for lower freight costs of commodities out of a region or country. There is a strong case for growers to work together in making more efficient use of packing, transport, and other logistical services. This principle is the basis of fruit cooperatives or companies comprising a number of growers producing fruit etc. in close proximity to one another, and sharing infrastructure and facilities.

Factors determining the size of the enterprise

The size of a production enterprise depends on:

- The availability of fixed and mobile resources, including suitable land in the right climatic area, sufficient good quality soil and water, capital, and skilled and unskilled labour.
- The targeted return on capital, and therefore the possibilities for optimising return on investment through economies of scale.
- The availability and condition of existing facilities, equipment, machinery and infrastructure, such as pump-houses, suitable roads, dams, offices, pack houses, spray machinery, tractors, trailers, animal handling facilities, sheds and vehicle maintenance units.
- The market demand for the range of cultivars that can be produced on the available land. If for, example, there is high demand for a cultivar/ breed which is suited to the area, but the market window is very short, care will have to be taken to ensure that the cultivar/breed is not over-produced, thus stretching the capacity of the resources over a short period of time.

Evaluation of the factors determining enterprise size

Of the factors listed above, a few taken in combination are critical in determining the size of a production enterprise:

The Trade Off between Production Efficiency and Market Demand

The ideal situation is to be able to produce large volumes of all the commodities the market most wants. This is however seldom possible, because at a single locality the climatic conditions suited to one favoured commodity may be unsuited to others.

It may for example be possible to produce high quality, early-maturing Star Ruby grapefruit in an area with a hot climate, which may be a winner on the market. It is however not possible under these same climatic conditions to produce one of the other market favourites, such as high-quality late-maturing seedless mandarins.

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In livestock production such as beef, there may be high demand and price for beef but the climate of the region may only be able to support smaller breeds like Ngunis or Afrikaners and larger breeding types like Charolais will not be able to adapt.

The grower in the hot area should therefore focus on producing grapefruit. He can do this effectively and efficiently, getting high yields of excellent quality fruit. The grapefruit harvest season however only lasts eight weeks. The principle of economies of scale says that he should plant other later maturing cultivars to spread his risk and his costs. But these cultivars may not be ideally suited to the region and so his overall or average production efficiency will not be optimal.

The breeder in an area less suitable for beef production has to choose a breed which will be able to withstand the climate and give a profitable yield of beef.

Sometimes growers are faced with the contradiction of being in a region where they are able to successfully produce those cultivars that only have a fair market demand, while struggling to produce those cultivars that are in high demand on the market.

Clearly a balance has to be struck and very careful planning has to be put into deciding on the ratio and overall quantity of the different cultivars to produce, given the market opportunities and the characteristics of the area.

It is this that plays an important role in determining the overall size of the enterprise: **The greater the opportunity to produce a range of market-desired products well, the lower the chances of outright failure in a particular season (risk), the larger the likely return on investment, and thus the larger the enterprise can afford to be.**

The Trade Off between Cultivar Suitability and Costs

Market forces will normally dictate that the more suitable a region is for the production of the greatest diversity of market-desired products, the more expensive the land and other resources will be. For example, the Western Cape is a region that has access to the full range of available export markets. Climatically it is also a region that can support the production of high-quality fruit and wine of the most desired cultivars. However, land for planting is scarce and expensive.

Here too, careful analysis is required to decide on the final size of the enterprise, taking all of these factors into account.

There will be circumstances where it will make sense for a grower to invest in two or even three production units located in different regions so that the full range of cultivars can be produced and packed under one brand name.

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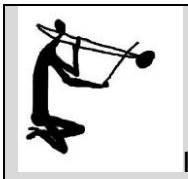
There are also instances where, for technical reasons, it may pay to focus all attention on just two varieties, so as to exploit the inherently high yield and quality factors related to the climatic conditions that best favour both of them.

It should be clear from the information given above that deciding on the size of a production enterprise is a complex issue that is dependent on the interaction of various factors. The ability to produce high yields of a spread of market-desired products coupled with the availability of key resources, of which capital is critical, are the defining factors. The financial or business plan that is able to interactively compare the merits of various options is a vital planning tool in this regard.



Individual Formative 3

PRINCIPLES OF QUALITY MANAGEMENT SYSTEMS

The meaning of quality

The term **quality** has been defined in many different ways, from simply *'a measure of excellence'* to more analytically *'a reduction of variation around the mean'*.

The definition could also be expanded to the following: *'Quality is the outcome of the sum of all of the features and characteristics of a program, process, or service that impact their ability to meet or surpass the needs and requirements of a customer*'. Quality defines desirable characteristics of a product, a process, or a service. For the purposes of this learner guide, the term quality applies to that of the agricultural product.

In agricultural commodities, good or bad, is evident in the appearance and characteristics of the product. It therefore has to do with the perception and expectation of the customer, and like beauty, is something that is in the eye of the beholder.

Quality is therefore a relative concept, and a moving target, depending on various factors that may happen to influence customers' expectations at any particular time. Thus, issues like the quality of competitors' products, price and the demand/supply balance all influence the customers' perception of the quality of a consignment or parcel of products at any given time.

Over a longer period, a particular source may develop a good quality reputation because it consistently meets or exceeds customer expectations. Consumers may come to associate this with a particular brand name and seek this in their purchases. This aspect is discussed further in the ***Marketing*** unit standard of this learning material.

Quality also refers to the extent to which the product is safe to eat. Food safety is not usually apparent to the eye. A situation can therefore exist where a product looks attractive, tastes good but is unsafe to eat because of high levels of chemical residues. Such a product could hardly be called 'high quality'. Thus, any reference to the term 'quality' in the fresh produce industry should also incorporate the concept of 'food safety'.

In the past, retailers used the quality of their fresh produce to differentiate themselves from their competition. Today, with the strong purchasing power of the supermarket chains, it is said that quality is a given. This simply means that in order to participate in this market the supplier, or producer, must be able to virtually guarantee a certain minimum quality standard regardless of whatever problems or costs he may encounter in achieving this.

Quality management and standards

Quality cannot be inspected into a product. This is another way of saying that the process of quality inspection cannot improve a product nor guarantee that, in the case of a perishable product, it will not deteriorate subsequent to the inspection.

Quality management is therefore more about the practices, processes and procedures used to assure the quality of a product, otherwise known as quality assurance (QA), it is about merely inspecting the product at any moment in its passage through the trade chain, which is quality control (QC).

The QA procedures and practices followed while the fruit is developing on the tree are critical in determining the final quality of the product. This is because, by the time the fruit is ready for harvest, its internal quality is fixed. This means that there will be no perceptible change in the sugar or acid content of the fruit after harvest. The rind of the fruit will also by then have developed certain characteristics that will make it either more or less prone to physiological disorders or waste.

In the livestock industry QA procedures is becoming an increasingly focussed on action. Most of the international and national markets dealing in meat etc. are forcing producers to up their enterprise's quality procedures to ensure a more uniform product and to guarantee good market prises.

Climate and nutrition are the overriding factors determining internal quality and in predisposing fresh produce to post-harvest quality and condition problems. Since little can be done to modify the climate, practices should be directed at reducing the possible negative effects of unfavourable climatic conditions in a sustainable manner.

It is also important to have systems in place for tracking the quality of the product as it develops. In the case of quality defects to the rind caused by insect or disease damage, this can be achieved by adherence to pest and disease control programs based on the monitoring of pest and disease levels.

Once product has been harvested and packed it has to be inspected, or quality controlled (QC), to determine its compliance to the South African minimum standards. The National Department of Agriculture (NDA), in conjunction with Perishable Products Export Control Board (PPECB) and various industry stakeholders, has developed these standards. The standards are updated annually and are aligned with importing countries' standards.

These standards comprise a detailed list of more than 30 different minimum requirements applicable to the external appearance of the product and an equally detailed set of standards applicable to internal quality factors. Included here are phytosanitary standards that apply to certain pests and diseases whose symptoms indicating their presence in the orchard and which importing countries have banned or placed certain restrictions on.

From a quality management point of view, actions can be taken during production, being pre-harvest, to reduce the risk of food-borne hazards, to keep production interventions to a minimum, and that will go a long way towards assuring compliance of the end-product to the requirements of the market. These actions are achieved through the implementation of **Good Agricultural Practices (GAP)**.

GAP includes the responsible use of pesticides, the reduction of soil, water and air pollution, worker health and hygiene, and facility sanitation. Various independent GAP systems have been developed as checklists for good agricultural practices. These practices, which are separate to importing government regulations, include **Eurepgap**.

In the mid 1990's, the Euro Retailer Group (EUREP), representing the leading European food retailers, agreed to accept and promote GAP. This was in response to increasing consumer interest in the impact of agriculture on food safety and the environment. Eurepgap was consequently established as a private non-profit organisation with its headquarters in Germany. In terms of Eurepgap requirements, suppliers, or producers, are required to demonstrate their commitment to:

- ♥ Maintaining confidence in food quality and safety.
- ♥ Minimising detrimental impact on the environment, whilst conserving nature and wildlife.
- ♥ Reducing the use of agrochemicals through adoption of Integrated Production Systems.
- ♥ Improving efficiency of use of natural resources such as soil, water air and energy; and
- ♥ Ensuring a responsible attitude to worker health and safety, welfare and training.

The Eurepgap standard comprises three categories of control points that require different levels of compliance. These are the major musts, (100% compliance required), minor musts (95% compliance) and shouldn'ts (recommendation level). The major and minor musts constitute most of the food safety-

related aspects at the production sites with strong emphasis on the regulation of GAP in the application of agricultural chemicals.

Good Manufacturing Processes (GMPs) provide the basic environmental and operational conditions that are necessary for the packing and/or processing of safe product. GMPs include pack house sanitation, the design and layout of the facilities and equipment within the pack house, and processes and controls. Such GMPs are required as the basis for a company wishing to implement **Hazard Analysis Critical Control Point (HACCP)** programs.

HACCP is a systematic approach to the identification, evaluation and control of food safety hazards involved in the process-flow of a product, and can be applied not only to the pack house, but to any other segment of the trade chain, such as production, harvesting, distribution, etc. The seven principles of HACCP are the following:

1. Identification and measurement of hazards.
2. Identification of critical control points.
3. Establishment of preventive measures with critical limits for each control point.
4. Establishment of procedures to monitor the critical control points.
5. Establishment of corrective actions to be taken when monitoring shows that a critical limit has not been met.
6. Establishment of procedures to verify that the system is working properly; and
7. Establishment of effective record keeping documents.

It is clear from the above that formal QA and QC systems and procedures are required for the successful production of export commodities. The more specialised the market requirements are, the more effective the QA and QC procedures need to be. The higher paying markets are usually those requiring proof of compliance to their specific quality standards. The producer needs to analyse the costs involved in meeting the quality standards of the different market segments available to him. Such cost/benefit analyses will assist the producer to decide on the overall strategy of his enterprise.

Individual Formative 4

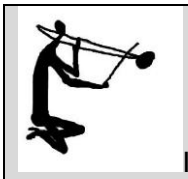
QUALITY CONTROL IN THE PRODUCTION PROCESS

Gathering of data

The following information will be discussed in relation to fruit and animal production, but could be adapted to suite any desired agricultural commodity.

Data relating to product quality is required as the basis for ongoing production decisions during the course of product development and maturity. However raw data, which normally comprises the many individual measurements taken of a particular quality factor or parameter, is of limited value in that form. Data has to be converted into **useful information** before it can serve as a useful tool for decision-making.

Data gathering and processing is an important aspect of measuring the response of production units and products to the various inputs made. Statistical analysis provides the tool for determining the significance of those responses.



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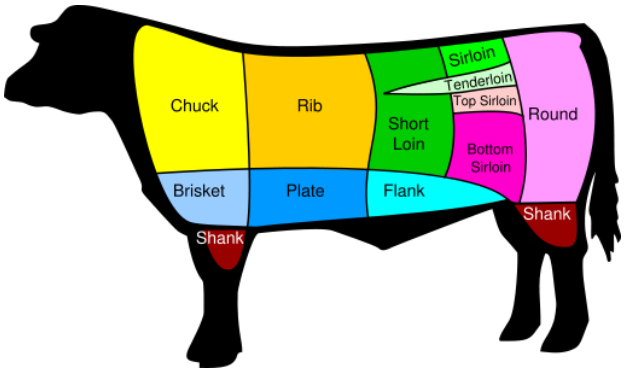
In this section we examine the process of gathering a product's internal quality data and converting it into information upon which harvesting and packing decisions can be made. The specific example used here is therefore that for **Maturity Indexing**, although similar data gathering principles could be used for pest and disease monitoring to determine when critical threshold levels have been reached to justify control treatments.

Maturity Indexing is a technique used to provide information on the rate of change of fruit maturity prior to harvest, or the final development of animal before it is ready for slaughter. Certain changes must happen in the carcass: The percentage of fat must be at an optimum to fulfil the markets requirement etc.

The maturity of animals may differ due to a number of factors: Type of breed, feed and climate are but a view to mention. Management must take this into consideration and plan feeding, transport and marketing accordingly.

In the fresh fruit industry maturity may differ by as much as three weeks from season to season, primarily due to the time of flowering and the weather conditions subsequent to it. This can have a major impact on management decisions relating to issues such as the contracting of labour for harvesting, the preparation of the pack house, and logistical arrangements for transporting the packed fruit from pack house to market.

A very advanced method to ascertain the maturity of beef and mutton before slaughter has been introduced into South Africa during the last view years. The animals are scanned with a light indicator that gives an accurate picture of fat distribution in the carcass. Although the equipment is expensive, larger enterprises are finding it more and more cost effective and ensuring that all animals slaughtered are 100 % market compliant.



Fruit samples are tested for acid and sugars and the ratio is calculated, and fruit colour is rated. The results of these quality factors are plotted on a graph. By doing so the data is converted into information which will begin to show clear maturity trends after a few weeks. This enables appropriate management decisions to be taken in good time.

As an example, in table 4.1, typical average weekly fruit size, colour, sugar, acid and ratio values for Clementines are given as a reference framework for maturity indexing purposes. The minimum national standards are given lower in the table as a control. In table 4.2, a typical Maturity Indexing information sheet template is given. The internal quality test data from each sampling is entered onto the sheet and the relevant points connected once sufficient samples have been taken to show trends.

Table 4.1

Below, the typical average weekly fruit size, colour, sugar, acid and ratio values for clementines is given as a reference for maturity indexing purposes.

Long-term reference framework for picking maturity and combined weekly average maturity progress (Industry)
Clementine

Week	*Date*	*Size (mm)*	*Colour*	*Hydro TSS (%)*	*REFRAK TSS(%)*	*Acid (%)*	*Ratio*
10	8 Mar	43.6	8.0	10.5	9.8	2.35	4.47
11	15 Mar	43.4	7.8	10.1	9.3	2.13	4.75
12	22 Mar	42.3	7.9	10.3	9.6	2.04	5.03
13	28 Mar	45.2	7.9	10.0	9.2	1.73	5.76
14	4 Apr	45.9	7.5	10.4	9.5	1.52	6.85
15	13 Apr	50.4	7.5	10.3	9.5	1.40	7.38
16	19 Apr	49.2	7.2	10.4	9.6	1.24	8.37
17	25 Apr	53.0	6.2	10.6	9.8	1.21	8.75
18	3 May	52.1	5.2	10.9	9.9	1.11	9.78
19	10 May	52.3	4.6	10.4	9.8	1.00	10.39
20	17 May	53.1	4.2	11.0	9.9	0.98	11.21
21	23 May	56.5	3.3	11.2	10.4	0.98	11.36
22	31 May	52.5	2.9	10.6	9.9	0.92	11.52
23	7 Jun	53.1	2.6	11.1	10.4	0.85	13.14
24	14 Jun	52.6	2.5	11.5	10.8	0.87	13.31
25	21 Jun	50.6	1.1	13.5	12.2	0.90	15.08

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PRODUCTION PRACTICES AND PROCESSES AFFECTING PRODUCT QUALITY

The following practices have a great influence on product quality:

Nutrition

This is the single most important factor determining the quality of the product being produced. The higher the input, the better the quality of the product. The stock farmer must remember to draw a link between cost of feed or feed supplements like licks and the increase that it creates in terms of quantity and quality of product produced.

Treatment of hooves

The hooves of animals should regularly be attended to, as lameness; due to hoof abnormalities may be detrimental to the grazing ability of the animal. The condition of the animal deteriorates and secondary infections such as foot rot may result.

Dehorning of cattle

The dehorning of cattle is recommended for various reasons; viz-polled animals cannot injure each other, especially in kraals, at dipping-tanks, at drinking and feeding troughs and in railway trucks. Losses due to wounds and bruises inflicted by sharp horns are avoided. Bruised meat on carcasses usually acquired by horn blows during transport, are condemned for human consumption at abattoirs daily, leading to losses amounting to thousands of rand annually.

Castrations

Male animals are castrated for various reasons. Castrations can be performed at any age, but preferably when the animal is still young (especially sheep, calves and pigs).

Advantages of castrations:

- In certain species of animals e.g., sheep and goats, the carcass of a mature male animal tends to have an offensive smell. This is not the case with castrated animals of the same species.
- Castrated animals tend to be more placid and therefore gain weight more readily. Handling of these animals is also facilitated.
- Propagation of a poor type of animal is prevented.

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Docking of tails

Advantages:

The docking of tails in sheep is necessitated because filth and dung accumulate under the tail (especially when diarrhea occurs) thus aggravating the blowfly menace if present. Tails should be docked at a young age to lessen shock. Lambing percentages will increase, as the tails of ewes do not interfere with the process of mating. Sheep with docked tails, due to their stocky appearance, are also more acceptable to butchers.

In citrus, a broad division can be made between factors affecting fruit quality caused by pests and diseases, and the physiological and/or cosmetic quality problems brought about by the effects of climate, nutrition and irrigation. In this section, the focus is on the physiological factors although similar principles are applicable to pest and disease factors.

In citrus production, each phase in fruit development is influenced by the preceding phases and influences the following phase. The phases are:

- ♥ Flower induction and initiation
- ♥ Flowering
- ♥ Fruit set
- ♥ Fruit growth
- ♥ Harvest
- ♥ Flower induction and initiation for the following years' crop.

Crop can be manipulated in various ways including fertilisation and irrigation, pruning, thinning (by hand and chemically), girdling, hormone application (to reduce flowering, increase fruit set, extend the harvest season, and extend the shelf-life of the fruit), fruit acid reduction and fruit colour improvement.

Table 4.3 is a typical management schedule, in this case for easy-peeler production in the northern areas of the country. The table indicates the timing of various treatments to achieve desired fruit set, fruit size and quality.

The citrus production manager should create such a management schedule for each of the citrus cultivars he produces. Over time, a database of the specific treatments and treatment timings applied annually to achieve a premium quality product should be developed. In this way the risks attached to the production of high-quality fruit will be systematically reduced.

Table 4.3 Management schedule

Guide to Annual Soft Crop Management Program – Northern Areas												
	Jan	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***
A. Fruit Set & Size												
Urea Sprays KNO_3 Sprays					X (1%) X (4%)	X (1%) X (4%)					X (4%) for Size	
Pruning & Blossom Thinning						XXXX		X	XX (Blossom Thinning)			
Girdling for Set					`				XX 2 Weeks			
N Applications (Soil)			Leaf Samples		¼ N – Soil (After colour break)				XX ½ N Soil	XX ¼ N Soil		
Fruit Thinning (by hand)	XXXX		XXXX (Sunburn)									XXXX
Corasil Y Sprays / XGR Thinning / Sizing											XXX	
Irrigation (for fruit set and growth)	"Quality Stress" (see below)			-50kPa					-30 to -50 kPa			-50kPa
B. Fruit Quality				**Harvest**								
Reduced Irrigation (Increased Sugars)	XXXX	Stress -60kPa XXXX	XXXX	Irrigate before harvest								
Calcium Arsenate – Reduced Acid											XX	
Maturity Indexing		XX	XXXX	XX	(6-8 weeks before harvest)							
Ethrel Sprays (Colour) + Ca Acetate for sensitive cultivars				XXXXXXXX (Colour break) Acetate one day before ethrel								
Degreening (Packhouse)				XXXXXXXX (from colour break)								
Summer Girdling (Higher sugars)												XXXX
C. Harvest Timing Extension				XXXX	XXXX	GA_3 at colour break or December						XXXX
Early Harvest			See ethrel / ethylene / calcium arsenate / summer girdling methods above									

X = Week of month during which activity is carried out.

The impact of various procedures and practices on product quality

For the purpose of explaining some of the practices which impact on product quality, it is necessary to understand the fundamental interactions between the environment, tree growth and fruiting.

Certain factors or conditions, either alone or in combination, gives rise to strong and vigorous vegetative growth in the tree. Such factors would include warm day and night temperatures, sufficient water, young tree age, high levels of nitrogen, no nutrient deficiencies, and the absence of root or leaf diseases.

When trees grow vigorously the quality of the fruit is usually poor. Fruit colour is slow to develop, the sugar content is low, and the fruit has an insipid taste due to low acid levels. Fruit is usually too large, have coarse rinds, and tree yields are only fair.

In animal or livestock production there are a number of factors that may have an influence on the quality of product. Climate, feed and certain actions performed by growers such as branding of animals, dehorning, application of pour-on for parasites and the injection of growth hormones are but a view to mention.

Cost / benefit Analysis for Quality Improvement Processes

The term cost/benefit analysis is used frequently in business planning and decision support activities. According to this source, the term does not refer to any specific approach or methodology, but usually implies a study to provide some form of financial justification for an action. Financial justification is a business-case analysis that helps the production manager to decide whether or not to proceed with a proposed action.

In deciding which quality improvement processes to employ, the production manager should conduct some form of cost/benefit analysis to determine whether the cost of implementing a specific action is financially justifiable.

The nature of the analysis would depend on the manager's ability to quantify the cost of the planned treatment against the financial benefit accruing from the action.

It is relatively easy to accurately estimate the cost of a prospective treatment, whether this is a chemical spray, pruning or the implementation of an amended fertilisation or irrigation schedule. In relation a livestock production manager must also adapt his practises to achieve the best quality product in the end with the most effective interventions like feed supplement

at the lowest possible cost. This may include time scheduling for medication etc. that is within the prescribed timeframe before slaughtering, changes in infrastructure to reduce physical damage to animals etc.

Estimating the financial benefit that could arise from the chosen treatment or treatment combination is usually less precise. This is because the quality of the final product is the result of a number of interacting factors, some of which are out of the control of the manager, such as climatic conditions.

The recommended approach is to use past records as an indication of the potential financial losses that could be incurred from quality defects or to estimate the cost of non-compliance to the relevant market standards.

Actions to address quality problems

The need for remedial actions, or interventions, to address quality problems is closely related to the inherent suitability of the site and climate to production of the chosen commodity. Production on marginal areas or on marginal soils requires more intervention than those established under more suitable circumstances.

For example, access to EU markets depends on the ability of the grower to demonstrate the absence of any symptoms of diseases that may depreciate the product at the time of inspection. This is more easily achievable in some areas than in others. Therefore, the cost of production in respect to areas that are more exposed to these negative factors will be higher.

Research has provided a wide range of remedial actions to address practically all circumstances that can give rise to quality defects in the final product. However, the challenge is to produce products with minimum intervention so as to keep production costs low and ensure a more economically and ecologically sustainable enterprise.


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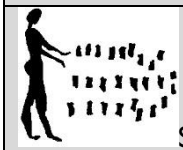
SUMMATIVE 2

Unit 3: Farm Layout and Planning

Farm Layout

Unit Standard	
116309	Implement integrated farm layout and site selection
Specific Outcomes	
SO 1: Prepare and categorise collected and recorded information in an agricultural environment to support the infrastructure development of an agricultural enterprise. SO 2: Demonstrate the ability to identify high and low yield potential areas according to a range of land use options and criteria. SO 3: Organise and plan infrastructure maintenance tasks related to the natural resource base of a farm, including the supervision of other workers. SO 4 Demonstrate the ability to monitor and maintain sustainability-based farm layout innovations that have been implemented in an agricultural environment as part of a land use plan.	

CCFO's		
Identifying Working Organise	Communicating Demonstrating Collecting	Contributing Science

Introduction

Life is complicated, as it is influenced by job opportunities, economy, crime, politics, etc. These factors must be arranged in such a way that we can create an atmosphere in which our families may live a sensible life.

The same can be said of a farming unit, although, in this case, it is influenced by factors such as:

- Topography: Is it suitable (flats) for crop production and cattle grazing or (hilly) for tree plantations, orchards and vineyards?
- Availability of natural resources: Sufficient running water for cattle and sheep; what about a river for irrigation purposes?
- Location of the farm: How far is it from a market (fresh fruit and vegetables) or silo (maize, sunflower and wheat crops)?
- Farming practices: The availability of workers must also be taken into account as fresh fruit, vegetables, citrus and vines need more labourers (handpicking) than cattle farming.
- Different enterprise possibilities: Sufficient rainfall, soil type, daylight hours and temperature to yield crops, or rather cattle breeding (Bushveld) where it is too dry and warm for crops?
- The availability of capital: Aid from the government, Bank loans or Contract based?
- The preference\experience of the farmer/owner (in a lesser degree) will also influence decision-making.

Do not forget factors such as:

- Intensity and direction of the wind,
- Average monthly minimum and maximum temperatures
- What time does the sun rise and set through the seasons?
- What is average annual vapour-transpiration rate of an area?
- What is the average humidity throughout the year?

These factors must therefore be integrated in such a way to ensure a sustained farming enterprise. To accomplish this task, the farmer will have to do some planning at first. Planning though, cannot be done without knowledge……and that is what this guide is all about!

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Information to support infrastructure development

Integrated farm planning

According to Allan Rosenburg and Thomas Landers, integrated farm planning, can be defined as: "To determine the existing and\or available resources on the farm, which resources will still be needed to maintain future goals and also to have an unmistakable objective of where you are aiming to?"

Definitions:

Integrated farm planning: Integrated farm planning (whole farm planning) thus, is a tool for developing a sustainable farming system.

Sustainable agriculture: Sustainable agriculture can be seen as a philosophy as well as a farming system as it has its roots in a set of values that reflects a state of awareness of ecological and social realities and one's ability to take preventative action. It also involves the design and management processes that work with natural processes to conserve all resources, minimize waste and environmental impact while maintaining or improving productivity.

Farm Layout: A Farm layout refers to the compiling of physical structures such as homesteads, outbuildings, waterways, contours, camps, water supply roads and the layout of orchards, vineyards or lands. However, the area where the farm is situated, the topography, the availability of natural resources, the farming practices, the different enterprises, the availability of capital and the preference of the farmer/owner will also affect the farm layout.

The principles of Integrated Farm planning are

- Whole farm planning is a process that assist farmers to analyse the farming operation
- Each production system must be planned and combined with the other systems
- Both the physical infrastructure and the economical and management inputs must be planed
- Accurate information need to be obtained to ensure proper planning

What role does Integrated Farm planning play in the success of a farming business? Integrated farm planning is one on the components that will contribute to the success of the farming business. There must be proper planning of the production system, marketing, quality of products and financial planning.

Steps involved in whole farm or integrated farm planning

The following steps are involved in whole farm planning

1. Setting of goals
2. Making an inventory and assessment of existing farm resources 3. Developing and implementing an action plan
3. Monitoring on-farm processes towards the goal

Step 1: Setting of goals

Whole farm planning begins with the development of a long-term goal or vision for the farming business.

The farmer needs to determine the following:

- The quality of life expectancy for his family and himself
- What is his vision or aim for the future of the farming business
- The amount of income needed from the farming business to ensure an atmosphere in which his family, his workers and their families may live a sensible life.
- The farming business need to determine long term goals e.g. the reduction of debt, the improving of soil fertility, etc. Short term goals e.g. the planning of tillage methods, diversification of crops or enterprises and the improving the marketing of products.
- Human and social resources which include the manpower available, the skills level and training of the different farm workers.
- Environmental resources
- Economic and financial resources

Step 2: Inventory and assessment

These goals should relate to the following resource areas to be able to properly plan an inventory of resources which include natural resources, human resources and financial resources.

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- **Natural resources** can be determined by using a farm map, soil maps, soil testing, and availability of water, veld types and vegetation. It can be obtained through the study of the maps and other documentation or by conducting a natural resource audit where the person collects the necessary data form the source.
- **Human resources** including manpower availability, the skills level and training of the different farm workers.
- The **financial assets or resources** are the capital available or the collateral the farmer has to secure a loan from financial institutions.

With this step in the planning process the farmer determined (stock take) which sources are available, how these can be used and the means of getting to the goals.

Step 3: Action plan

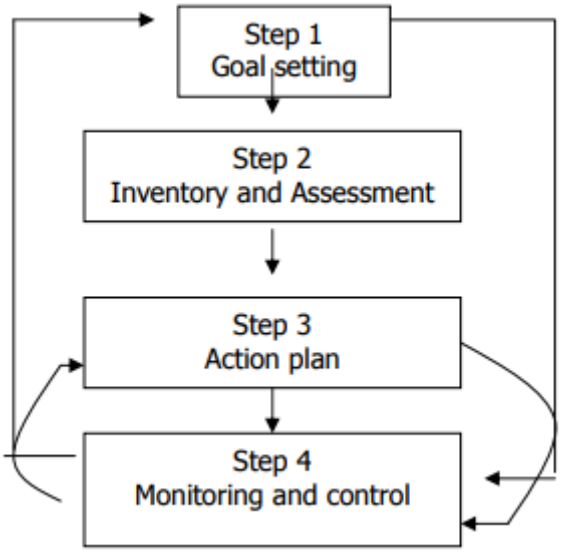
The planning that was done in the previous steps needs to be put in action. The management alternatives need to be identified and evaluated and then be used to develop an action plan.

The action plan must fit in with the goals set in the first step and must make use of all existing positive resources as it can influence future planning.

Step 4: Monitoring and control

Management alternatives must be evaluated separately to determine which plan suites the farming business best. As the whole farm plan is implemented, you need to evaluate the different options and plans to determine if it works. It might be necessary to make minor adjustments to the plan as time goes on. Keep accurate records and evaluate to see if the farming business is still on the right tract and achieving the goals set out

.



What role does integrated farm planning play regarding the conservation of natural resources?

Whole farm planning assesses the physical aspects of the farm with regards to soil, vegetation and topography. This physical stocktaking of the farm is then the basis of farm design and layout.

This may include soil conservation structures, water supply, irrigation and the improvement of natural vegetation or the eradication of alien plants.

- The implications of integrated farm planning.
- The implications of whole farm planning enable the farmer or the manager to consider the natural resources and take all the internal and external factors into account when decisions are made concerning the production systems, type of products produced and the marketing of the products
- The importance of integrated farm layout.
- The focus of integrated farm planning is to consider the entire production of possible agricultural products and to plan the farm infrastructure in such a way that it complements the production process; it also ensures the sustainable use of the natural resources.
- The main considerations when doing Integrated Farm Layout.

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- The main consideration of whole farm planning is to ensure sustainability and balanced management of the whole property in the long term and to encourage the farmer or manager to develop risk management and drought management strategies as a means of increasing his self- confidence and viability.

	**Group Activity 1**

Selecting an enterprise and production site

What are the principles of site selection?

To evaluate the farm in its whole, it will be necessary to draw a map indicating the farm's topography, boundaries as well as soil and water resources. This is essential information needed in the planning process when selecting a site for a specific purpose, e.g. building a dam or waterway; the layout of a new land etc. North – eastern slopes are preferred for maximum sunlight, warmth and protection from winds. Slopes do have a tendency to erosion and need to be cultivated with care. Soil erosion can be prevented by not using slopes with a gradient of more than 7° when cultivating for crops.

Pay attention to the following when production sites are selected

- Soil types, soil depth and fertility
- Drainage of the soil
- Availability of water
- the natural vegetation
- Access to the area

During the process of selecting an enterprise on the farm one will also take into account the information regarding natural resources and the specific needs for the different enterprises. The natural resource base must be able to sustain the selected enterprise. The following should be taken into account:

- Water flow onto and off the farm.
- Terrestrial (land) and aquatic (water) living organisms found on the farm.

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- Expected biomass to be removed from farm and required inputs to replace the loss.
- Establishing of natural resources like thatching grass or reeds that can be harvested at a sustainable rate.

Site selection is important to ensure that cost is kept at a minimum. Correct drainage can take place, runoff water can be controlled. In the case of feedlots or dairies where a large number of animals are kept in camps the drainage and runoff of water is very important. The site for animals and animal products must also be away from water sources to prevent pollution of the underground water. In the case of certain fruit trees, the slope of the hill and the amount of sunlight and heat units will play a role in the quality of the fruit or product.

To assist with site selection the land type maps and memoirs from the Department of Agriculture can be used to give detail about the following:

- Soil and terrain data
- Climatic data for the given land type
- Climatic date according to climate zone
- Land type inventory and description of soil, soil depth and the presence or absence of structures that effect the infiltration of water.
- These Land Type Maps and memoirs can be ordered from the department of Agriculture. Division of Agricultural information. Private bag x 144 Pretoria.

When a Land Type Map is ordered for e.g. 2623 Vryburg, then request for a 1:250 000 LAND TYPE SERIES 2623 VRYBURG with accompanied memoirs. The Land type maps and information is also available at www.agis.agric.za. The land type inventory is compiled by the Department of Agriculture and provides information regarding the following:

- Terrain – a profile sketch indicating the highest and lowest point as well as the different slopes
- Percentage level land is estimated
- The local relief is also estimated
- Terrain units are also indicated
- The Geology
- Soil depth, soil series (soil with slopes of less than 12 % and no mechanical limitations are indicated as plough-able soil) • Climate zones are indicated
- Rainfall indicated

- Evaporation as measured in class A- evaporation pan
- Temperature – heat units, highest and lowest temperature
- Frost – the first day and the last day and the duration of the frost period

What role does site selection play regarding the conservation of natural resources?

With the selection of a production site the various internal factors such as topography, soil and climatic factors need to be considered. One must also keep in mind the natural vegetation and the ecology of the area, determine (by means of ecological studies) if this area is not an ecological sensitive area where cultivation is prohibited e.g. vlei areas or where the slopes are too steep.

The Land use inventory describe the soil as follows

- Soil series present
- Soil –rock complex
- Solid rock
- Rivers and streams
- Pans
- Erosion
- Swamps
- Shifting dunes
- Coarse deposits

Mechanical limitations associated with each class of land are described in terms of the classes set out below. The limitations are due to the size and quantity of stones and/or depth or shallowness of tillable soil.

MB0 – No mechanical limitations
MB1 – Many stones, but plough able
MB2 – Large stones and boulders, un-plough able
MB3 – Very shallow soils on rock
MB4 – Lack of soil

The profile description method

This method is based on the Soil Survey Manual (1951) and describes the following:

Stone size and quantity:

Stones larger than 250 mm in diameter and rock projections are grouped together since both of them have an effect on soil use, e.g., interfering with the use of agricultural machinery and dilute the soil mass.

Class 0 – No stones or bedrock or too few stones to interfere with tillage

Class 1 – Sufficient stones or bedrock to interfere with tillage, but not to make inter-tilled crops impracticable

Class 2 – Sufficient stones or bedrock to make tillage of inter-tilled crops impracticable, but soils can be worked for hay crops or improve pasture if other soil characteristics are favourable

Class 3 – Use of all but very light machinery and hand tools impracticable, forestry and grazing possible

Class 4 – Use of all machinery impracticable, forestry and grazing possible

Class 5 – More than 90% of the land surface covered by stones or exposed bedrock.

Erosion:

The different kinds of erosion can be described as follows:

Sheet erosion – The uniform removal of the topsoil from an area without the development of conspicuous water channels

Ribbed (rill) erosion – Removal of soil through the cutting of numerous small but conspicuous water channels

Gully erosion – Removal of soil giving rise to deep channels or gullies

Wind erosion – Removal of topsoil by wind

Different classes of erosion:

Class 1: None apparent or slight

Class 2: Moderate loss of topsoil and/or some slight dissection by runoff channels or gullies

Class 3: Severe loss of topsoil and/or marked dissection by runoff channels or gullies

Class 4: Total loss of topsoil and exposure of subsoil and /or deep intricate dissection by gullies

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	**Group Activity 2**

Basic infrastructure layout requirements

The layout of a farm is planned according to the activities that will be implemented, the structures and infrastructure required by these activities, also the natural resources and natural landscape of the area. Health regulations and the Occupational Health and Safety Act (OHS Act) must also be taken into consideration with the planning of Agricultural facilities. The list below provides a few examples of structures and infrastructure that could form part of a farm. It is impossible to provide a list that is applicable to every farming enterprise.

Layout requirements and considerations	
Access / transport	Farm produce must be transported from the farm to markets and silos while inputs are brought onto the farm. Consider the distance that must be travelled and the condition of the roads. Make sure access roads can be used in wet weather conditions to prevent damage to vehicles and produce.
Beehives	Keep away from people. Must be close to forage and water sources. Needs sheltered areas; protection from wind.
Borehole	Situated at underground water source – consider how water will be pumped to where it is needed.
Bridges	Make sure these do not interfere with wetlands. Take maximum flood levels into account. Make provision for water to flow underneath without blockage.
Compost heaps	Close to material and water source. Ease the transportation of end-product to where it will be used or sold. Facility to sieve and do the packaging.
Cattle handling facilities	Close the other cattle facilities (kraal). Ensure safe handling and movement for animals and handlers during a working (e.g. selection) process.
Dams	Preferably higher than the area to where water will be used so that water can be gravity fed. Ideal sites for catching excess rain water and to block up streams or rivers.
Electrical generator	Consider noise and length of cables. Alternative sources for electricity or heating –solar heating
Farm house	In an unproductive area, but centrally located on the farm to save on transport costs. Ideally also placed for good visibility, such as to look out for fires.
Fencing	Separating specific activities on the farm, different grazing camps and security.
Fields\lands	In areas with high productive possibilities, but consider access routes, slopes

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	and soil types, contours and water ways
Firebreak	On the boundary where fire is likely to come from. Take legal requirements into account
Food stores	Closest to where the animals are fed. Safe from fires
Grazing	Consider the suitability of grazing areas. Divide into camps based on herds and carrying capacity. In areas where tilling (ploughing) is impossible.
Input stores	Closest to where it will be used. Consider storage requirements of materials, e.g. temperature, humidity, etc. OHS act in handling of chemicals and flammable products
Intensive food garden	If appropriate, nearest the farmhouse.
Irrigation	Access to water is crucial for success of any farm. To save on installation costs, the use of gravity-fed systems should be exploited to the maximum to keep the need for pumps to a minimum
Milk sheds / milking parlour	Consider input requirements; electricity and water. Consider walking distance for cows to-and-from the milk sheds. Transportation of milk to dairies (e.g. Clover, Dairy Bell). Health regulations need to be obeyed.
Nursery / greenhouse	Access to water, inputs, electricity. Consider transport of produce to market. Keep wind direction and temperature in mind. Biosecurity.
Orchard	Access to water and pack house. Consider theft and pollination. Climatic conditions need to be taken into account with some fruit cultivars. Bio-security.
Pack house	Consider proximity to fields, orchards and place of production. Consider condition of the road (bruised fruit, etc.).
Poultry shed	Access to water and proximity to feed. What about slaughter options; if on site, then electricity and storage must be considered. Theft - security. Bio- very important. Health requirements.
Water reservoir	How is water pumped, and how far? The longer the distance, the higher the capital and maintenance costs.
Windbreak	At right angles to the prevailing wind.
Woodlot	Keep away from fire hazards.
Workshop	Closest to where vehicles are stored. Enough space to work on farm machines. Layout and neatness according to OHS Act.

The following can influence farm layout

- The financial position of the owner
- The different farming enterprises
- The production systems used to produce a product.
- The topography of the farm
- The intensity of the system

- The climatic conditions of the farm
- The product produced
- Rules and regulations applicable to agricultural sector.

Infrastructure influence productivity, yield, cost, quality and other agricultural inputs in the following ways:

- Better infrastructure will ensure a better-quality product.
- Yields can be enlarged due to the better management and application of the necessary inputs.
- The cost can be controlled as the damage to products is reduced and better infrastructure make it easier to achieve the production goals

Intensive or extensive and other farming systems

Definition:

Intensive farming system: An intensive farming system can be described as an integrated production enterprise where environmental conditions are controlled, feed and water are plentiful, rations are carefully balanced, excellent health control measured are in place and programs are carefully monitored and temperature, humidity and other weather influences are controlled. Large production forms a small area of land.

Examples of intensive animal production: systems are integrated poultry enterprise, integrated pig farming and large dairy operations, cattle and sheep feedlots.

The following is an indication of the difference between intensive and extensive system:

	Intensive system	**Extensive system**
The management input	Very high management input	Low management input
Area of operation	Small area	Large area
Production levels	Very high	Moderate to low
Cost	High costs High Capital investment	Less costs Low capital investment

The following are examples of extensive farming systems:

- Crop farming
- Animal production
- Subsistent maize or sorghum production
- Beef cattle on natural grazing

- Dry land maize in the dryer areas of the RSA
- Sheep farming in the Karoo
- Farming with goats in rural areas
- Subsistent poultry farming

Factors that need to be considered for intensive crop or animal production

Intensive crop farming:

- Are there natural resources available e.g. water for irrigation or high rainfall?
- What is the condition of the soil, will it sustain intensive agricultural production
- The climate of the specific area.
- Does the climate suit the product or must adjustments be made?
- Soil cultivation for optimal production, aim is to provide ideal environment for germination and growth
- Choice of the correct cultivar that is capable of high production
- Plant density and planting method
- Scientific fertiliser program or foliar feed program
- Weed and pest control programs and the use of technology to determine insect infestation or pheromones to attract pests Precision farming with records via satellite technology
- Harvesting of the product to ensure quality
- Value adding to the product – washing and grading of potatoes before packing
- The availability of human resources – skills of the workers
- Market for the products and distance from the market
- Input costs and cost of implements and equipment

Animal systems:

- Feeding of the animals, well balanced rations are needed to ensure fast growth Feeding system
- Total Mixed Ration (TMR) or grazing with additional concentrate feeding or intensive grazing system under irrigation.
- Climate control – provision of heat or cooling
- Inoculation and disease prevention Scientific selection and breeding
- Breeding system - AI or natural breeding

- Cross breeding or pure breeds Choice of the breed for the specific production
- Handling facilities Housing system and climate control
- Waste disposal Availability of water – will there be enough water for the animals?
- Availability of human resources and skills level
- Distance from the market and size of the market
- Input cost and cost of equipment
- Bio security measures

With extensive crop and animal production systems you need to consider

Crop production

- Climate and rainfall - to adjust plant density, row spacing and choice of crop
- Cultivation methods to conserve moisture and to build up organic material
- Cultivars choice
- Inputs in relation to the expected yield
- Methods to reduce the runoff of rain water and water harvesting

Animal production systems

- Natural resources – soil, vegetation and water
- Facilities such as camps, water provision and fire breaks
- Roads and other infrastructure- handling facilities at cattle or sheep posts needed to reduce the distance animals must walk to the handling facilities.
- Human resources and skills level of the workers
- Fences to protect the animals from predators
- The use of natural shade and wind breaks for animal protection against climatic conditions

Layout of the farm can influence the following:

Productivity	Poor layout can affect production negatively as it can lead to waste of energy that could be used for production. Waste of time and additional work from the labourers due to poor layout can also lead to lower productivity. Poor facilities or inadequate facilities can slow down the production process or effect it negatively
Yield	Animal comfort can affect the yield of production positively or negatively if animals experience discomfort Poor facilities can cause diseases such as

	mastitis and foot-rot - dairy cattle Cannibalism can develop in chicken runs and pigsties where animals are stressed
Costs	To cure foot-rot and mastitis is an additional cost Mortalities due to cannibalism or poor housing facilities cause a loss of income Animals that are not housed in correct facilities use more feed and energy and produce less
Quality of the product	Poor facilities or layout can result in damage to the products and it lowers the quality of the products Bad roads can damage fruit or vegetables Cooling facilities can improve the quality of the product. The lack of electricity can affect the quality of the product if it cannot be cooled for a long period
Input costs	Input costs increase due to waste if the feeding facilities are not functioning correctly. Incorrect planters or facilities can also increase the input cost. The provisioning of infrastructure is a cost that must be recovered from the product produced

Definition:

Aquaculture production systems: Aquaculture is the production of fish and other seafood products in either fresh or salt water. Aquaculture can also be defined as the growing of animals that normally lives in water. This production is done mainly in dams, either earthen or dams constructed specifically for the purpose. The seawater production is normally done on platforms in the sea.

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The following should be considered for the layout for an aquaculture system:

- Stable water supply and how the oxygen level of the water will be kept at the required level
- Dams for breeding and growth of the water animals
- Slaughtering and packaging facilities for the processing of the products on the farm.
- Cold storage where processed products can be stored, and the cold chain need to be maintained through the delivery process,
- Breeding dams or facility for breeding stock
- Hatchery where the eggs can be hatched, and the fingerlings can grow for the first few days
- Equipment to catch the fish
- Market for the product and the type of product the market prefers.

The aquaculture systems can be very intensive, or it can be done expensively in the farm dam.

Aquaculture can be divided between fresh and saltwater systems.

Fresh water system	Saltwater system
Catfish farming	Avalon farming
Trout farming	Muscle farming
Koi fish farming	Scrimp farming
Crocodile farming	Ouster farming
Frog farming	
Tilapia fish farming	

Fish farming can also be used for recreation and Agric tourism, for the anglers to catch fish such as Bass, trout and other sport fish. Crocodile farms are usually a tourist's attraction.

Horticultural production systems:

Horticulture is the practice of science of growing flowers, fruit and vegetables. This can be done extensively or intensively in greenhouses. Most of the fruit production areas are intensive farming systems. Systems that can be used for horticulture production are hydroponics system, rock bed systems or NTF systems, micro irrigation systems and drip irrigation systems.

The latest trend is to produce organic fruits and vegetables where only organic fertiliser is used and pest and weeds are controlled organically or biologically. The following are some examples of products that can be produced in horticultural production systems:

Flowers	Vegetables	Fruit
Roses Carnations Tulips Other Cut-flowers	Tomatoes Peppers Egg plant Water melons, melons Butternuts and other pumpkins, baby marrows, Cucumbers Cabbage, Cauliflower, Broccoli and Brussels sprouts	Deciduous fruit Citrus fruit Sub-tropical fruit

The following need to be considered for horticultural production

- Climatic conditions – warm and cold temperatures
- Soil – suitability for production
- Availability of water
- Combination of products Production system and production facilities needed
- Market for the product and type of product required by the market
- Disease and pest control

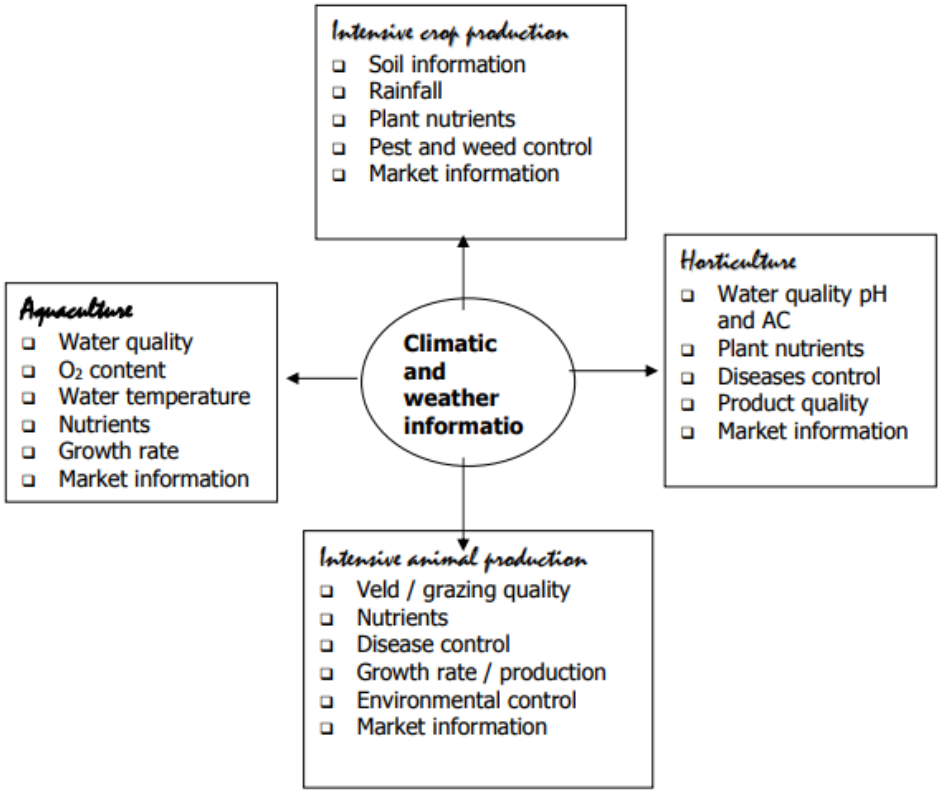
	**Individual Activity 3**

Data collection

Data needed for successful farm and production layout

To produce quality products, it is necessary to ensure that a production system is planned, the farm-layout is suitable and that everything possible is done to ensure a quality product.

The following data can assist with the layout and the production planning:



Data is needed by management for planning and to make correct decisions. It is therefore It is It is important that the available information is correct and complete.

Data collection

- Data collection must be accurate, guesstimates are not scientific collected data be collected at the same intervals be relevant be over a specified period (a year, growth season) use the same units be collected at the right time (daily, weekly etc)

- Data can be collected using various methods collect it yourself use instruments e.g. Weather station, tensio-meters, Information can be collected from the internet and satellite information Send samples away for analysis observations

Data collection is done with various instruments:

- **Thermometer** – measure temperature on a specific scale; we use Celsius as the scale with 0°C as freezing point and 100°C as boiling point, A minimum and maximum thermometer is normally used to indicate the minim and maximum temperature of the day

A alcohol wet ball thermometer is used to determine the temperature of a fluid Soil temperature can also be determine

- **Rain gauge -** is available in various forms; the most common one for use is a plastic cone that is erected in an area where there is no obstacles to influence the measurements
- **Tensio-meters** – measures water tension in the soil, indicating when to irrigate or not and what the water status in the soil is.
- **pH and EC meters** – this instrument is used to determine the pH – level of acidity of fluids and the electro conductivity of the fluids
- **Evaporation pan**. The evaporation pan is used to determine the daily evaporation rate of water from an open surface. This instrument is used in the scheduling of irrigation

Data collection is the recording of data on a regular basis and at the same interval to determine any changes. This recording must be accurate. In most cases the collection of data involves the writing down of information e.g. temperature and rainfall quantities.

Data collection also involves the taking of samples that need to be analysed or send away for analysis e.g., soil, water or milk samples. The purpose of this is quality control and to find information.

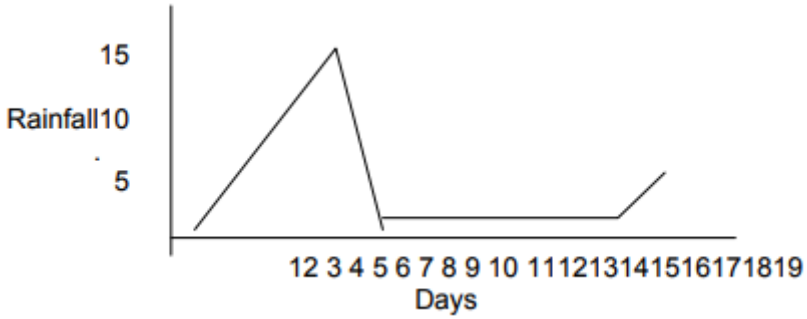
Parts of the plants can also be used to collect data e.g., leave analysis to determine whether the plant received enough nutrients; or fruit analysis to determine whether the product is ready for harvesting. Animal products can be analysed to determine quality, or to determine disease infection, e.g., mastitis test in milk before milking and Somatic cell counts. Blood smears can also be taken to be observed under a microscope or blood samples send away for analysis.

	**Group Activity 4**

Data presentation

Data must be presented in an uncomplicated and understandable way to ease management's decision-making process.

Rainfall information will be captured daily on a monthly or weekly rainfall recording sheet and can be presented in the form of a graph.



Data collected must be used to make decisions and not only collected for the sake of data collection. Data can be presented in different formats

Format	Description	Examples
Table	Tables are used for comparisons and to show information clearly	Weekly egg production
Graph	Graphs are used to show tendencies and movement of information. Assist in conspicuous changes that might occur. Different types of graphs can be used	Daily sales of milk or daily production of cupflowers
Spread sheet	Spread sheets are used to gather large quantities of information and to record it in an orderly way.	The quantities of oranges harvested from different orchards
Poster	Provide information to everybody that want to look at the data – used for training and information.	Packing or grading % of fruit or potatoes in pack shed
Data Sheets	To be completed when data is collected - the aim is to organise the information	Recording of the quantity of fruit picked by the workers

Days harvested:

Workers	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	30	40	35	40	35	30	20	35	40	25	40	35	
2	10	15	15	15	10	15	12	15	12	10	15	15	
3	15	20	25	30	30	30	25	15	20	25	20	25	
4	25	30	25	20	15	20	20	25	20	25	25	20	
5	40	45	35	40	30	35	40	35	20	30	35	40	
6	30	40	35	40	35	30	20	35	40	25	40	35	
7	10	15	15	15	10	15	12	15	12	10	15	15	
8	15	20	25	30	30	30	25	15	20	25	20	25	
9	25	30	25	20	15	20	20	25	20	25	25	20	
10	40	45	35	40	30	35	40	35	20	30	35	40	

Data can be processed by hand or it can be captured on a computer where it is stored and used to present information. Various new data lodgers are available to assist with the electronic capturing of data to eliminate the human factor. This is an example of the use of data in a Piggery where an AI (Artificial Insemination) program is implemented.

Example:
The sow's inseminated date is recorded in a computer program. The following information will now be available; Next heat date. Possible furrowing date (giving birth). Inoculation Program for this sow. Feeding program. Date when she must be prepared for furrowing.

Ubuntu farming company

Sow no	Next heat	Possible furrowing date	Inoculations	Feeding program	Date to be prepared
06/22	22/11/07	25/02/08	E-coli – 02/02/08	2kg per day extra from 2/02/08	23/02/08

The manager of the dry sow unit can use this data to observe the sow and prepare her for furrowing; this will ease management and increase productivity and production. The School for Bio Resources Engineering and Environmental Hydrology of the KZN University developed the ACRU model that can be used to determine the effect of water on the soil and crops. www.beeh.unp.ac.za. Other computer models are available for e.g. irrigation scheduling.

Individual Activity 5

Service providers

Service providers, in the context of infrastructure, farm layout and enterprise selection, are people that can supply the farmer with information, services or material to provide, maintain and develop infra structure on the farm.

Service providers can be

- Consultants that provide the farmer with advice on the lay out of the farm or enterprise selection as well as the use of different products.
- Trained agricultural engineers, or soil technicians can assist with the measuring of the farm, the planning and design of structures such as dam, roads, contours and waterways
- Technical staff to advise the farmer on irrigation design, methods and planning of the systems
- Representatives from seed, fertiliser, herbicide and pesticide companies
- Extension officers from the department of Agriculture or the Co-ops can also assist the farmer with the planning and enterprise selection
- Suppliers of material for the developing of the infra structure
- Inspectors from the department of health
- Buyers from different commodity brokers
- People that do repair and maintenance work on the farm buildings, equipment and other infra structure.

The role of service providers

Service providers play a supportive role to support the farmer or manager in the planning of the infrastructure. They can also assist with the whole farm planning and advice on financial and marketing matters.

What kind of information can be obtained from service providers?

- Advice on financial matters
- Advice on labour matters
- Advice on mechanisation and equipment needed
- Latest development in the production field • Marketing advice and quality control
- Advice on pest and disease control with animals
- Advice on weed and pest control in plants
- Advice on feeding and care for animals
- Advice on fertiliser and cultivation methods

What is a database?

A database is a list of information that is compiled for a specific purpose, e.g. an address list of herbicide suppliers in your area. The farmer or manager can compile the information from different source documents, newspaper, agricultural magazines, personal contact, telephone directory and the Internet.

The importance of having a database of service providers:

- Once the list is set up correctly, information can be withdrawn in a nick of time.
- The database can put you in contact with the correct person to solve your problem
- Prices can be compared when inputs need to be purchased
- Alternative suppliers can be selected without delay

Service providers that can assist with the analysis of data or can provide programs to analyse the data are

- ARC – at their various sections for different commodities
- Input suppliers e.g., fertiliser or pesticide companies - soil and leaf samples
- Product processors – Milk co-ops, fruit packers, wine makers
- Computer software distributors
- Internet – SA weather service
- AGIS web page www.agis.agric.za for satellite photos of the farm
- Universities, Agricultural Colleges, and other research institutes
- Commodity brokers • Bank officials dealing with Agriculture
- Suppliers of tractors and implements
- Market agents
- Transport contractors
- Agriculture contractors

The following information should be captured in a database of service providers.

Name of the company	
Contact details	Phone number Fax no Postal Address Physical address e-mail address web site
Name of Representative	
Contact details of rep.	Phone number Fax no Postal Address Physical address e-mail address
Products /services provided	
Previous dealings with the supplier	
Map how to get there	

Use of the land

Land use options intensive and extensive

Intensive farming produces large quantities of food or products from a small piece of land, but need much more inputs such as water, fertiliser, facilities and management; e.g. producing vegetables in tunnels or net houses, dairy farming, piggery and feedlots. A small piece of land is thus used to achieve maximum production. Extensive farming produces products over a large area e.g., beef cattle, sheep farming or game farming where animals are kept on natural grazing at the determined carrying capacity. Fewer inputs are needed, but so will the income also be.

The following example can be used to explain the concept:

		Intensive	Extensive
	Grazing	Cultivated pasture under irrigation	Natural veld depending on rain water
	Camp sizes	Small with large amount of animals	Large with a relative small amount of animals
	Carrying capacity	25 sheep /ha	1 sheep on ½ ha
	Animals on 10 ha	250	20
	Input costs	Fertiliser Electricity for irrigation Irrigation equipment Fences Internal parasite control	Fences Water provision - wind mill and dam Control of predators Less control of parasites
	Income	Higher due to larger number of animals and higher lambing %	Less due to lower number of animals
	Profit	High Income less high expenses = Ave profit	Lower income less lower expenses = Ave profit (lower than intensive due to lower numbers)

Use the following criteria to differentiate between the different farming systems

Farming system	Intensive	Extensive	Subsistent
1) Management inputs			
2) Capital			
3) Facilities			
4) Area used			
5) Production			

Land use plan

A land use plan is part of the production planning that must be made either for a short term (1 year) or for a long term (5 years). The farmer, with the aid of service providers or the extension officer of the DoA, can compile the land use plan.

The following information must be included in the land use plan:
General Information - Where the area is situated, the name and registration no of the farm
Physical information - size of the land, history of previous crops, soil detail record of cultivation and treatments

1. Crop rotation to prevent the building up of diseases – planning how this can be implemented
2. Seed and cultivars to be planted – to keep record and to determine the best cultivars for the specific area
3. Different crops need different nutrients and should complement each other – fertiliser needed
4. Nutritional and organic material status of the soil –obtained from soil analysis and if it is done on a yearly basis the nutritional situation in the soil can be monitored. 5. Water and wind erosion – How it can be prevented and if it is present, how can the area be rehabilitated
5. Economic factors such as price of crops - supply and demand will be needed to decide which crop can be produced
6. Input costs – what is the cost of cultivation - how can the costs be reduced etc.
7. Record keeping - records must be kept assisting with decision making process.

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	**Individual Activity 6**

What kind of data is found in a land use plan?

The land use plan will contain

- climatic or weather data
- production data • financial data
- present and historic data

Why is a land use plan so important in farm planning and farm layout?

The land use plan assists the farmer or manager with

- The planning and budgeting - inputs that will be needed in the production process.
- estimation of the income
- record activities that took place - now the farmer can see what or when the different activities must be repeated
- Planning - the correct cultivars and quantity of fertiliser.

An example of a land use plan:

Land use plan - Cultivated lands 2008								
	Land 1		Land 2		Land 3		Land 4	
Land size (ha)	45.57		39.08		39.9		11.9	
Soil								
Soil Type								
- Classification								
- Depth								
- Clay %								
Sub soil								
Soil Fertility								
Organic material content								
Nutritional status								
N								
P								
K								
pH level								
Slope								
Production History	Crop	Yield	Crop	Yield	Crop	Yield	Crop	Yield
2004								
2005								
2006								
2007								
AVE yield								
Crop to be planted								
Cultivar								
Cultivation								
Primary cultivation								

Land use plan - 2008
Page 2 of 2

Secondary cultivation	Land 1	Land2	Land 3	Land 4
Planting date				
Seed used (kg)				
Row width				
Space between seed				
Plant depth				
Germination %				
Weed control				

Herbicide used

Date	Product	Appl	Product	Appl	Product	Ap	Produ	Appl

Spraying for pest and disease

Pest	Product	Appl	Product	Appl	Product	Appl	Product	Appl
Fertiliser application	**Type**	**Kg**	**Type**	**Kg**	**Type**	**Kg**	**Type**	**Kg**
With planting								
Top dressing								
Foliar spray								
With irrigation								

Rain fall or irrigation	mm received	mm received	mm received	mm received
Date				
Plant population	Plants/ha	Plants /ha	Plants/ha	Plants/ha
Yield estimation	Kg /Ha	Kg/ha	Kg/ha	Kg/ha
Actual Yield	Kg/ha	Kg/ha	Kg/ha	Kg/ha
Price per unit				
Quality of product				

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The completed land use plan is a source document for the production planning for the next season

- It assists with crop rotation
- It assists with cultivar selection and also crop selection
- It keeps record of all activities on the land
- Assist with planning for the next season
- Assist the farmer or manager to be more effective and to save on costs

The farmer, his manager and other advisors can use the land use plan to obtain the correct information to ensure that the production process is aimed at achieving the highest yield and the best quality products at the lowest cost.

Land A 20 ha	Land B 40 ha
Land C 55ha	Land D 10 ha

Crop rotation plan of UBUNTU farms (Land utilisation for summer crops)				
	Land A	Land B	Land C	Land D
Year 1	Maize	Maize	Sunflower	Sugar beans
Year 2	Maize	Sunflower	Sugar beans	Maize
Year 3	Sunflower	Sugar beans	Maize	Maize
Year 4	Sugar beans	Maize	Maize	Sunflower
Year 5	Maize	Maize	Sunflower	Sugar beans

The land use plan assists the farmer in:

- Planning for cultivation
- Planning for production inputs –budget
- Planning income

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Natural resources

Natural resources in agriculture are the soil, water, vegetation, sunlight and rainfall. These are natural resources and cannot be replaced once it is destroyed.

Soil

Soil is the basis on which everything is build; it is also the growth medium for plants, trees and scrubs to grow in. It is the solid part of the earth. Soil can be divided into three main groups: sand, loam and clay soils - each with its own characteristics and qualities. It is important to know these characteristics will influence the production process and erecting buildings on the farm.

Water and rainfall

Rainfall is the main source of water – nothing will survive without it. Water, thus the main role-player, will ensure the success of crop production or vegetative growth. Soil water - rainwater captured deep underneath the soil surface - is another source of water (boreholes). Harvesting of rainwater in dams can be used to strengthen the underground water level and can also be used for irrigation or drinking water for livestock. Water from rivers and large dams (e.g., Loskopdam Scheme) is used for irrigation of crops.

Vegetation

Natural vegetation is the cheapest source of roughage for livestock and game. This natural vegetation must be managed with care - prevent soil erosion, do not allow over grazing - these will lead to veld deterioration and lower production. The lower production of vegetation will have a negative impact on animal production. Veld management - one of the most important management tasks of a livestock farmer.

The farmer must know

- the composition of the veld
- if it is improving or deteriorating
- indicator plant species - that can indicate the condition of the veld
- the growth patterns and value of the different plants
- the grazing habits of the livestock

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Sunlight and temperature

Sunlight is necessary in the photosynthesis process and to provide the correct temperature for plants to germinate and grow. Sunlight can be used to generate energy through solar heating and photocells. Pollution can be minimised by making more use of sunlight energy and less fossil fuels which have a negative effect on the environment.

Maintaining the infrastructure on the farm

Tools needed for routine repair work

Routine repair work will depend on the type of farming activities that is taking place on the farm.

Repair work can be divided into the following	
Routine repair and maintenance	The service of a tractor at regular intervals. Lubrication of equipment before and during use. Replacement of components before it can break and cause long delays
Preventative maintenance	Before and after the production season the equipment is serviced and inspected to ensure that it is still in a good working condition.
Corrective maintenance	The immediate repair of something that broke down or replacing worn implement parts before it is used the next production season.

Each of the production activities will require different tools and it will depend on the situation.

A few examples can be given:

Farming system	**Tools needed**	**Use of the tools**
Cattle / sheep farming	Pair of Pliers Wire strainer Wire Plastic pipe Pipe fittings Ball valve Sheep sheer Spade	To fix fences and water pipes To fix fences To fix fences and water pipes Fix water leaks Fix water leaks Replace faulty valves To cut wool in case of worm infestation or injuries To open water pipes
Crop farmer	Spanners, hammer, screwdrivers Grease gun	To do minor repairs Daily lubrication Repair equipment

	Welder Gas welding equipment Grinder Wheel spanner and jack Tire repair kit and equipment Compressor Oil, grease and filters	Cutting and repair of equipment Repair flat tires Lubrication and service
Irrigation	Spanners Piece of wire Spare sprayer heads, drippers or micro-sprayers Pumps Fan belts or drive cup-links Clamps	To replace sprayer heads To open blocked sprayers To replace broken sprayers Service pumps and motors Service centre pivots, gearboxes and electric motors Fix burst main lines
Tunnel farming	Extra plastic Tape or glue Drippers Clips	Repair damaged plastic before it becomes bigger Replace drippers not working To provide stability to plants
General	Spades Ladders Wheelbarrows Buckets Welder Angle grinder Other electric hand tools Building equipment Wood saws Picks	Moving soil or other products Repair broken equipment Building new structures

Repair and maintenance schedule

It is important to follow a maintenance schedule ensuring that equipment is kept in a good running order. Service intervals must be according to the manufacturer's specifications. Remember to alter the service and maintenance intervals according to working (dusty, stony) conditions.

Pre-season maintenance	Make sure the equipment is ready for use - replace worn parts, test it to ensure all components are working Service and lubricate all moving points - grease nipples Calibrate sprayers for correct application.
Maintenance during use	Daily – Lubricate, check water and oil levels, before commencement of work and after lunch break

	Fill with fuel at the end of the day Check tire pressure Clean air filter Clean the equipment Weekly – Check for worn parts Lubricate when it reached the required no of hours Replace oil and oil-, fuel- or air filters Wash after use before parked away for the weekend or when moving from one land to the other Prevent the spreading of weeds or diseases.
Post season maintenances	Replace all worn parts Clean thoroughly Wash after use Service and lubricate before parking Store in place where it cannot be damaged Disinfect facilities such as shearing sheds or packing facilities

	**Individual Activity 7**

Quality-management system

There are various models available to use and each company will develop its own system or adapt a system to suit their needs. The following is necessary in a quality management system.

- Knowledge of the product
- Performance or quality standards
- Corrective action if the standards are met
- SOP's – standard operational procedures
- Quality control
- Team work - everybody in the production line is responsible for the product's quality.

Knowledge of the product

Everybody involved in the production process must be informed and aware of what exactly is expected for a product's quality. It should be a team effort, and everybody involved in the process must get feedback regarding the achievement of their goals. Every worker in the

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process must thus take ownership of his\her work, knowing what their contribution will be in achieving a desired product.

Performance or quality standards

Every worker in an agricultural enterprise / business must know exactly what is expected from him\her and what standard of performance is required from them. To achieve this, the workers must have a clear job description and will be evaluated according to performance standards set for a specific job. They must receive feedback on areas of improvement and\or achievement. The workers must be informed about the consequences – a reward for good achievements or the 'backdoor' for poor performance.

Corrective action if the standards are met

If the staff member does not achieve the required standards of performance a counselling or retraining activity should be put in place where the staff member is informed of his /her short comings and how it should be corrected. The person must be given a time limit for the required improvement of standards and if that is not achieved a decision about further employment must be made.

SOP's – standard operational procedures

There are standard operational procedures in every business that must in place to ensure that the product produced will be of the required quality and standards. The person in charge of these procedures must be aware of these activities and must ensure that they are done timely and without fail.

The following example can be used to illustrate the concept

Activity	SOP
Cultivation of Vegetables	Correct seedbed preparation Planting of plants or seeds Irrigation – scheduling, cleaning of filters Fertilisation Testing of water quality Disease control - preventative program Picking and treatment of products
Raising of calves	Take away from mother after 12 hours Make sure it took in sufficient colostrum in first 12 hours Daily feeding according to program Inoculations according to program Cleaning of the pens on daily basis Protection against colds or drafts

Quality control

It is the duty of the manager or the supervisor to control the quality of work and the quality of the product produced. In some instances, a person will be appointed with the main function of quality control and must then ensure that the desired quality is produced, and standards are maintained.

Some quality control systems start with the individual worker to control him\her and aim at improvement of his work. This can be achieved with recognition of excellent work. The supervisors, at different levels, are responsible for the quality control to ensure that the agreed desired outcome is achieved within the funds limits and at the lowest cost.

Teamwork

Everybody in the production line, from the worker on the land to the manager or the farmer, is responsible for the quality product needed. Everybody must understand the concept of quality control and the part they play in achieving this goal. The workers, as a team must get regular feedback (e.g., Monday morning meeting) on successes – 'worker-of-week\month – or shortcoming and where improvements are needed. A worker must get credit for work well done to either boost his\her ego or urge them to keep on with the good work.

The team will also share in the success if the goals are achieved. It is very important that everybody involved in the process feel that their contribution, how small it may be, is appreciated and valued. Workers should also be encouraged to make suggestions or proposals to improve the production process or quality to let them feel important and part of the team. Corporate clothing, brand name and team building activities at the start or the end of the production cycle can contribute to team building. The end result - the farming unit as a whole will benefit by establishing a name or brand name on the market, resulting into higher demand and thus higher prices.

	**Group Activity 8**

Sustainable farm layout innovations as part of the land use program

Repair and maintenance to constructed infrastructure

Constructed infrastructure normally has a long productive period and routine maintenance must be done to prevent deterioration. These facilities must thus be inspected on a regular basis and the founding recorded. A scheduled inspection program must be in place to ensure that maintenance and\or repairs are done in good time.

Ubuntu farms maintenance schedule of infrastructure							
	2007	2008	2009	2010	2011	2012	2013
1) Roads grade and repair	X	X	X	X	X	X	X
2) Roads re-gravel and build up.			X				X
3) Paint farm buildings outside	X						X
4) Paint pack shed and equipment		X				X	
5) Maintain contours and waterways			X				X

Prevention of erosion

Water and wind erosion can be prevented in various ways. Wind erosion can be prevented by leaving vegetative matter as a ground cover on the soil's surface. Windbreaks can also be used to prevent wind erosion. Natural wind breaks such as trees, scrubs and tall grass or a constructed windbreak from wooden poles and shade netting can be used. Lands that are compacted by heavy rain can also be loosened with a tine implement and it will stop the wind erosion.

Gazing must not be over utilised leaving bare areas where the top soil can be blown away with strong winds - always leaving some plant material for protection.

<u>Water erosion</u>

Water erosion occurs in lands, along roads and waterways. The force of strong running water initially washes the topsoil away and if no preventing measures are taken, it will end up in a donga. Precautionary measures to prevent erosion:

- Water must flow in the natural direction with the contours of the land.
- The contour ridges in the lands must rectify the slope angles to slow down the water flow.
- The lands must be planned in such a way that the contours deposit the water into a water way (with grass covering) to take the water out of the lands.

- Contours, roads and water ways must be maintained and ensure that there is good grass covering to slow down the water flow.

Structures to prevent erosion

Bare areas

Areas without natural vegetation need to be camped off to prevent activities, other than precautionary measures, to occur. Use a single tine ripper and rip across the bare patch to break the flow of water. Implant seed or seedling in the loosened rows to regain a ground jacket.

Steep slopes

Strips of grass or other vegetation can be planted and make small erosion barriers with shade cloth\nets to assist with keeping the vegetation in place.

Waterways

Silt dams can be constructed to slow down the water and allow the silt to be deposited; eventually the dam will fill up and stop the erosion. Reeds or bamboo can also be used to slow down the water flow. Wire baskets can be filled with rocks and placed as an embankment to create a weir that will slow down the water and allow slit to be deposited. Run-off water from the catch-up areas can be embanked in a small dam and the overflow running into another small dam etc. A large dam, if allowed by topography, can be build and the water used for irrigation.

Group Activity 9

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Improvement of water absorption of the soil

The availability of water to soil can be increased by taking steps to increase the water absorption and retention of soil.

- Increase the organic material content of the soil - it improves the water holding capacity

- Leave Stover or plant material on the soil to prevent the run-off of rain water.
- Certain cultivation practices assist with the water absorption and the prevention of evaporation.
- Make contours to slow down run off water, allowing more time for water absorption.
- Plant covering - assist soil to minimise evaporation.

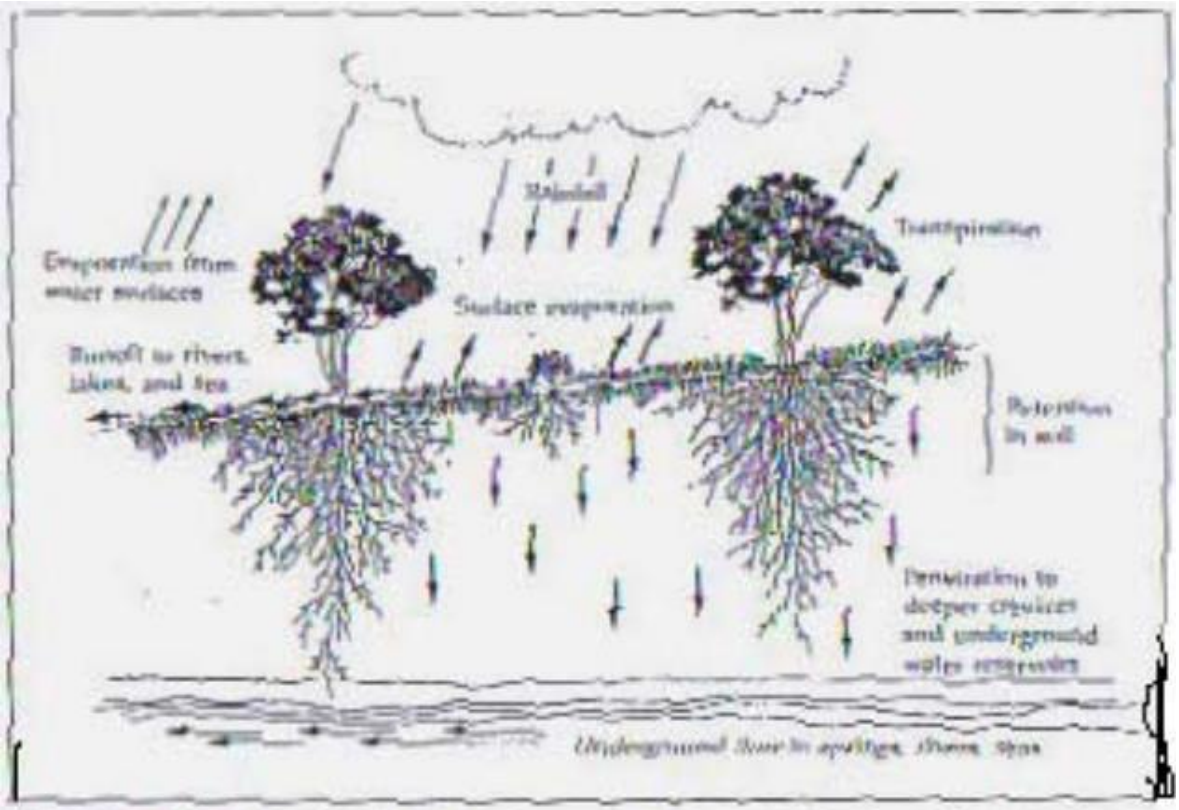
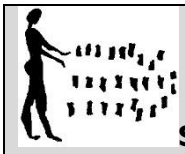


Figure 10-1. The water cycle.

Eradication of alien plants

Alien plants such as blue gum and black wattle trees use a tremendous quantity of water. The abolition of these plants along streams and in the catchments areas of rivers and dams will reduce the competition and the use of water. A plant's water-need will vary in different seasons, production stages of the plant and the soil type. The crop farmer must ensure that he chooses the correct cultivars for his area and that he keeps the drought resistance of the cultivars or type of plant in mind.

	**Individual Activity 10**



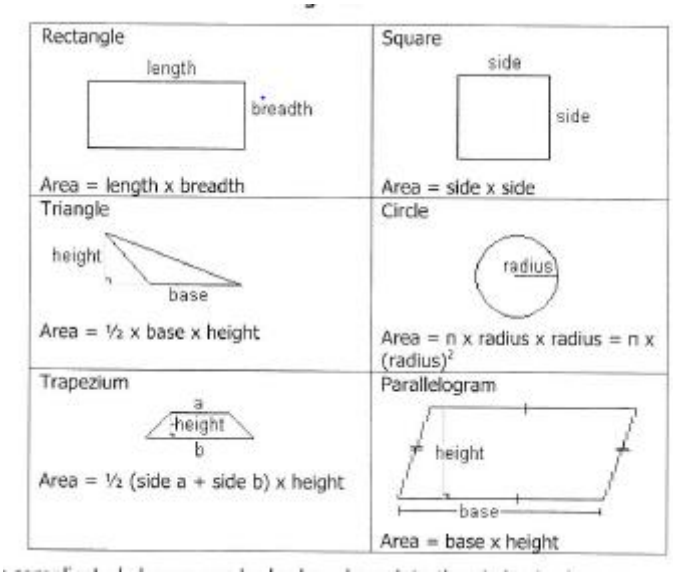
SUMMATIVE 3A

Geometric Shapes

Unit Standard	
12417	Measure, estimate & calculate physical quantities & explore, critique & prove geometrical relationships in 2 and 3-dimensional space in the life and workplace of adult with increasing responsibilities
Specific Outcomes	
SO 1: Measure, estimate, and calculate physical quantities. SO 2: Explore, analyse & critique, describe & represent, interpret & justify geometrical relationships.	
CCFO's	
Identifying Collecting	Communicating Contributing

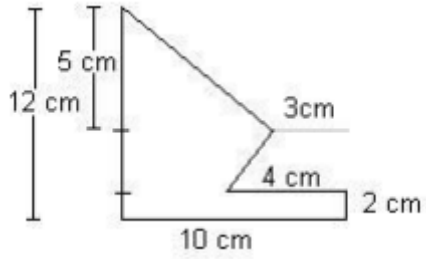
Properties of geometric shapes

Surface area of two-dimensional figures

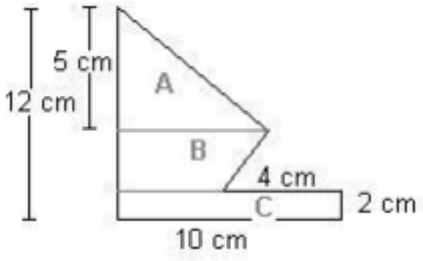


Most complicated shapes can be broken down into the six basic shapes shown above.

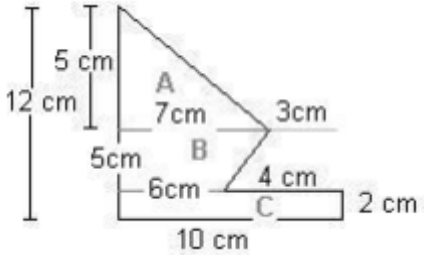
Calculate the surface area of the shape below.



Step 1: Construct lines to divide the shape into any combination of the six basic shapes.



Step 2: Calculate the missing lengths



Step 3: Calculate the areas of shapes A, B and C

Area A (triangle) = ½ x base x height = ½ x 7cm x 5 cm = 32,5cm2

Area B (trapezium) = ½ (7cm + 6cm) x 5cm = ½ x 13cm x 5cm = 32,5cm2

Area C (rectangle) = length x breadth = 10cm x 2cm = 20cm2 Step

4: Add up Areas A, B and C to obtain total area

Total surface area = Area A + Area B + Area C

= 32,5cm2 + 32,5cm2 + 20cm2

= 85cm

Surface area of 3-dimensional figures

To calculate the surface area of a three-dimensional figure, we need to break the shape up into known shapes by creating a net diagram. If you had to cut out the net and fold it, it would give you a 3-d shape.

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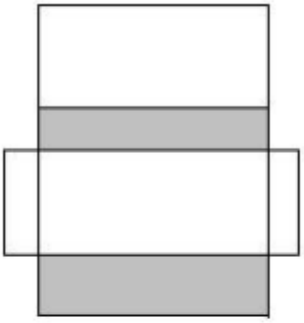
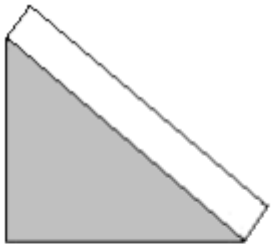
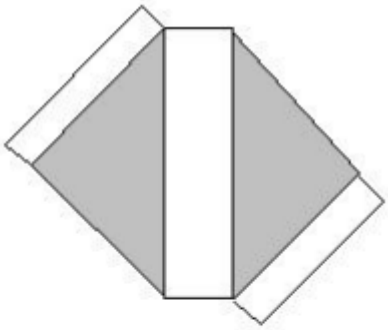
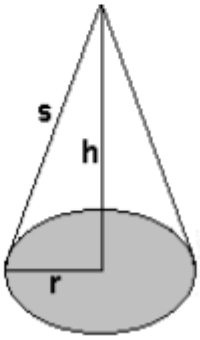
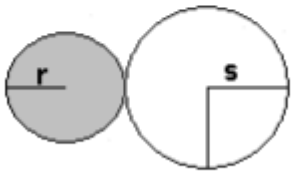
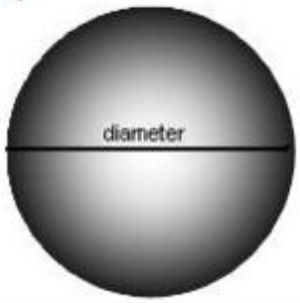
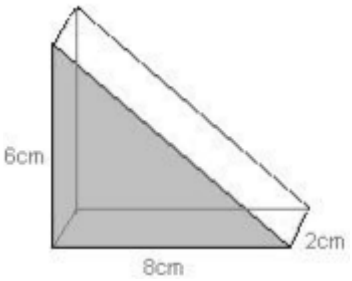
3-D shape	Net diagram
Rectangular prism 	
Cylinder 	
Triangular prism 	
Cone 	

Sphere	Area of sphere = $\pi \times d^2$
	

Calculate the surface area of the triangular prism below:



The length of the longest side of the triangle needs to be calculated by Pythagoras:

Hypotenuse^2 = 6^2 + 8^2 = 36 + 64 = 100

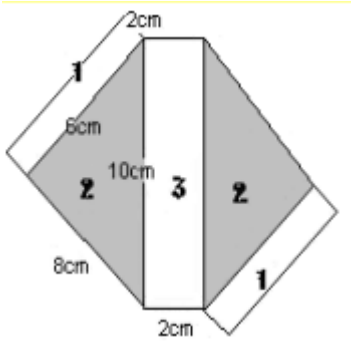
Hypotenuse = 10cm

We prepare a net diagram:

Total surface area = 2xarea 1 + 2xarea 2 + area 3

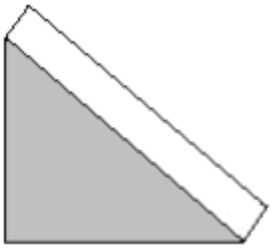
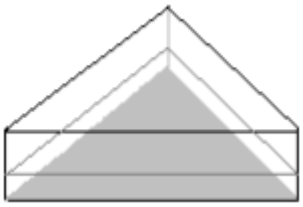
= 2x2cm x 6cm + 2 x ½ x 8cm x 6cm + 2cm x 10cm

= 24cm2 + 48cm2 + 20cm2 = 92cm

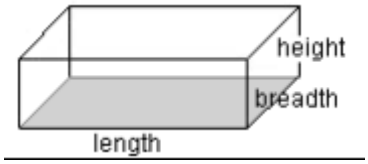


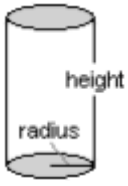
Volume of 3-dimensional figures

Many three-dimensional shapes are right prisms. If a right prism is cut into slices that run parallel to the base, then all the slices have the same cross section. A right prism can also be described as a three-dimensional shape in which the sides are at right angles to the base. All the sides must then have the same height. For example, the triangular prism is a right prism. The shaded area is the base, and the sides all form 900 with the base. The sides are all the same height.

 The triangular prism is lying with its base pointing towards you.	 The same prism is now lying on its base. The dark grey line indicates a slice that can be cut. The slice has the same shape as the base. The sides of the prism are all the same height. The sides are all perpendicular to the base.

The rectangular prism, the cylinder, the triangular prism and a prism that has any other shape as its base are all right prisms. The cone and the sphere are NOT right prisms.

3-D shape	Volume
Rectangular prism 	Volume = area of base x height = area of rectangle x height = length x breadth x height

Cylinder 	Volume = area of base x height = area of circle x height = πr^2 x height

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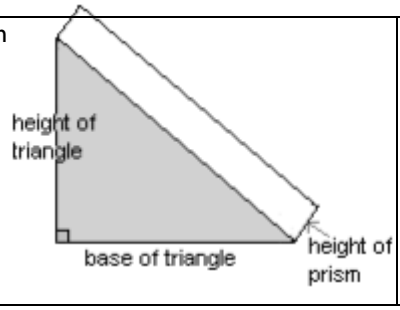
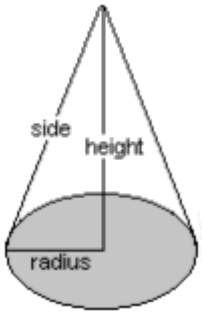
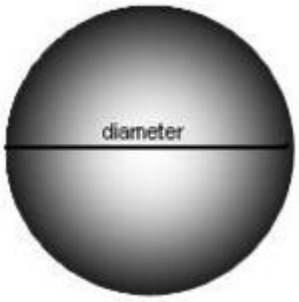
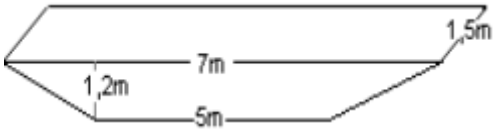
Triangular prism 	Volume = area of base x height = Area of triangle x height of prism = ½ x base of triangle x height of triangle x height of prism

Cone 	The volume of a cone is one third of the volume of a cylinder. Volume = (Area of Circle x height)/3 or = ($\pi \times r^2 \times$ height)/3

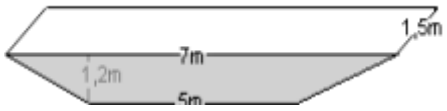
Sphere 	Volume = $\pi \times (\text{diameter})^3$ 6

Example:

A farmer needs to calculate the volume of a walk-through dip tank that he plans to build. The dimensions and shape are given in the drawing below.



First, we need to identify the base of the prism. The base is a trapezium. Volume = area of base x height = area of trapezium x breadth of tank = ½ x (7m + 5m) x 1,2m x 1,5m = 10,8m



Example:

A farmer has a round water reservoir on his farm. He wants to work out how much water it holds. The reservoir has a diameter of 15m and is 2m deep.

The base surface is either the top surface of the reservoir, or radius.

The radius is half of the diameter, i.e., 7,5m

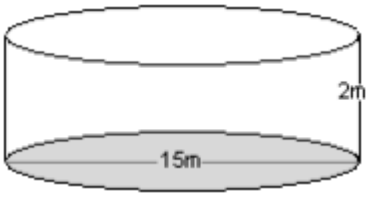
Volume = area of base x height

= area of circle x depth of tank

= πr^2 x depth of tank

= π x 7,5m x 7,5m x 2m

= 353,43m^3



Spatial interrelationships

Orthographic drawing

Orthographic drawing is the basis of all engineering drawing, and it is also the basis for the study of Descriptive Geometry. A well-trained engineer or technician must be able to pick up a drawing and understand it. This understanding, of necessity, involves the basic principles of orthographic drawing. Generally speaking, a course in Engineering Drawing consists of drawing various objects in two or more views utilizing the principles of orthographic projection. These views may be projected on the three principal planes – horizontal, frontal and profile – or on auxiliary planes. In turn, the views may or may not be sectioned. Many students entering a learnership have had limited experience in orthographic drawing in the high school or technical school which may have prepared them for the learnership. It may have only consisted of several weeks of Mechanical Drawing, but this previous contact with the principles involved in orthographic drawing forms a frame of reference which usually proves valuable in solving

Engineering Drawing problems. The question might then be asked, "Well, what is Descriptive Geometry?" Very briefly, Descriptive Geometry is the graphical solution of point, line and plane problems in space. These solutions are accomplished by means of the same principles of orthographic drawing which are involved in making a simple three-view drawing of an object. Orthographic Projection – the use of parallel lines of sight at 90o to an image plane.

Figure 1 is of a 3-dimensional object that is represented by top, front and side views.

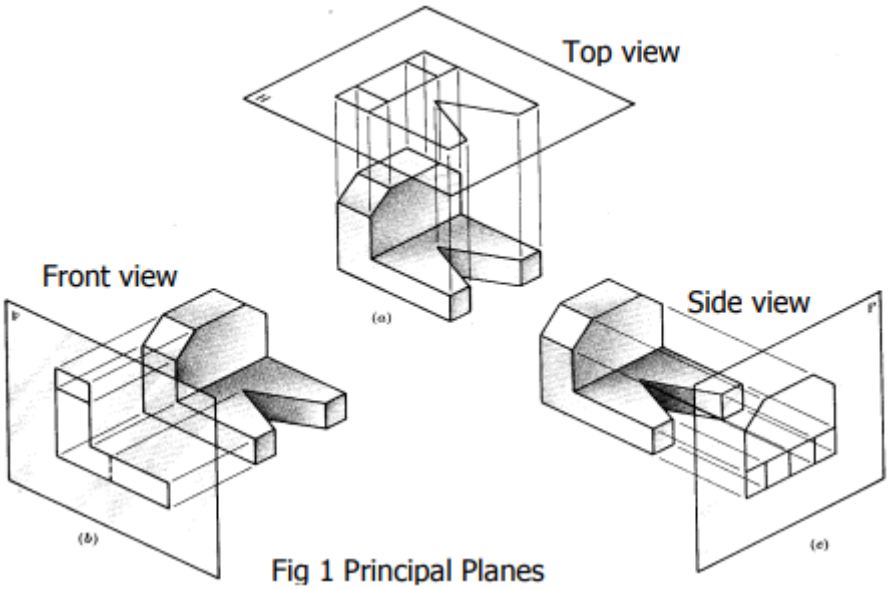


Fig 1 Principal Planes

Cuts and fills

Of the many types of problems encountered by farmers, one of the most common is that of reading contour maps. Sometimes soil needs to be removed from one place (cut) to be placed in another spot (fill), for example when land is being levelled (see Fig. 3 below). The following are some of the terms used in locating cuts and fills:

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• Profile – a vertical section of the earth's surface containing a given line which may be either straight or curved. The length of the profile must be equal to the true length of the given line. (See Fig. 2)

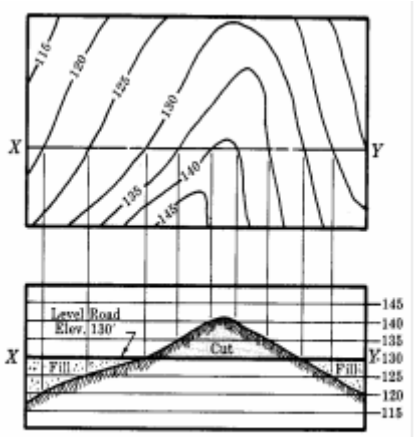

Fig 2 Profile of contour map

• Section – a vertical section at right angles to the profile line.

• Cut – earth removed to obtain a required slope or elevation.

• Fill – earth added to existing contour in order to obtain a required slope or elevation.

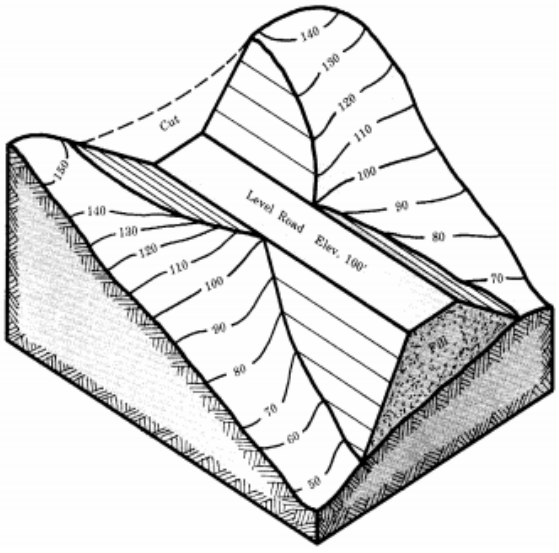

Fig 3 Three dimensional view of contour map

	**Individual Activity I**

Individual Activity 2

Measuring instruments

General measurement system

It is the nature of human beings to measure things in order to understand them better, or to be able to make comparisons. We measure time in years, hours, minutes or seconds, distances in terms of kilometres, meters, centimetres or millimetres. Every single variable that we measure has its own units and is measured by some kind of tool. You are invited to refer back to the Level 2 module 12444 in which a number of different tools were described.

Calibration

The most commonly used measuring instrument is the ruler. The ruler is by nature very imprecise. Any other measuring instrument has to be calibrated to make sure that the results obtained are accurate. Just think of your wristwatch! Every now and again you set the time on your watch according to the time given on television or radio. You are in fact calibrating a measuring instrument.

The Vernier and micrometer also need to be calibrated. When they are used a great deal, their measuring faces wear out. How can the user be sure that the measurement is correct? Let us take the Vernier as an example. If you close the Vernier completely you should get a reading of zero. If you do not get a reading of zero, you adjust a little screw at the back of the instrument until you do get zero. Now you know that your instrument is accurate. Any scale measuring mass is provided with some kind of standard. The standard is a block, usually of metal, of known mass. You simply place the standard on the scale and see what reading you get. If the reading is different to what the standard is supposed to be, then you adjust the scale until the reading is correct. Complicated measuring equipment can be calibrated periodically by the manufacturer, or it can be adjusted by the South African Bureau of Standards (SABS). You will then be supplied with a certificate of calibration. Calibration is so important, that you can win or lose court cases based on the correctness of your measuring apparatus. For example,

you are entitled to ask for proof of calibration of the machines that police use for setting speed traps. Any laboratory result will only be declared accurate if the laboratory calibrated its measuring equipment.

Static calibration

The most common type of calibration is known as a static calibration. The term "static" refers to a calibration procedure in which the values of the variables involved remain constant during a measurement, that is, they do not change with time. In static calibrations, only the magnitudes of the known input and the measured output are important. An example is a mass scale.

Dynamic calibration

In a broad sense, dynamic variables are time dependent in both their magnitude and frequency content. The input-output magnitude relation between a dynamic input signal and a measurement system will depend on the time-dependent content of the input signal. When time-dependent variables are to be measured, a dynamic calibration is performed in addition to the static calibration. A dynamic calibration determines the relationship between an input of known dynamic behaviour and the measurement system output. Usually, such calibrations involve either a sinusoidal signal or a step change as the known input signal.

Accuracy

The accuracy of a system can be estimated during calibration. If we assume that the input value is known exactly, then the known input value can be called the true value. The accuracy of a measurement system refers to its ability to indicate a true value exactly. By definition, accuracy can be determined only when the true value is known, such as during a calibration.

Precision and bias errors

The repeatability or precision of a measurement system refers to the ability of the measuring instrument to give the same result again and again and again. If a measuring instrument always provides the same wrong value every time, then the instrument is considered to be precise, but not accurate. The average error in a series of repeated calibration measurements defines the error measure known as bias. Bias error is the difference between the average and true values. Both precision and bias errors affect the measure of a system's accuracy. The concepts of accuracy, and bias and precision errors in measurements can be illustrated by the throw of

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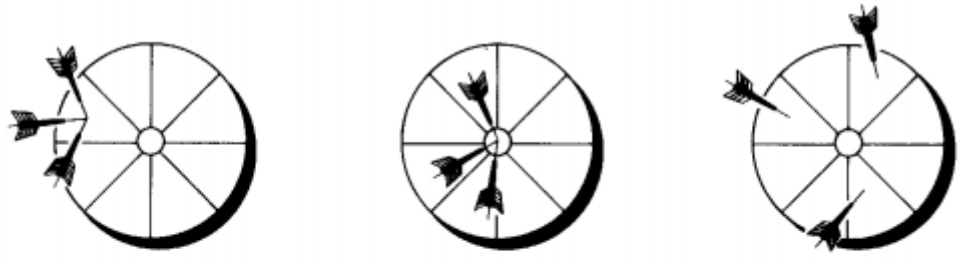
darts. Consider the dart board of Figure 6 where the goal will be to throw the darts into the bull's-eye. For this analogy, the bull's-eye can represent the true value and each throw can represent a measurement value.

In Figure 6(a), the thrower displays good precision (i.e., low precision error) in that each throw repeatedly hits the same spot on the board, but the thrower is not accurate in that the dart misses the bull's-eye each time. This thrower is precise, but we see that low precision error alone is not a measure of accuracy. The error in each throw can be computed from the distance between the bull's-eye and each dart.



(a) High repeatability gives low precision error but gives no direct indication of accuracy

(b) High accuracy means low precision and bias errors

(c) Bias and precision errors lead to poor accuracy

Figure 6. Throws of a dart: illustration of precision and bias errors and

The average value of the error yields the bias. This thrower has a bias to the left of the target. If the bias could be reduced, then this thrower's accuracy would improve. In Figure 6(b), the thrower displays high accuracy and high repeatability, hitting the bull's-eye on each throw. Both throw scatter and bias error are near zero. High accuracy means low precision error and low bias errors as shown. In Figure 6(c), the thrower displays neither high precision nor accuracy with the errant throws scattered around the board.

Measuring basic quantities

The Unit Standard requires of you to estimate or measure quantities such as length/distance, area, mass, time, speed, acceleration and temperature.

Individual Activity 3

Individual activity 4

Distinction between certain quantities

Mass

The mass of a body refers to "how much matter" is found in the object. Mass causes an object to have weight. Mass is a quantitative measure of the property described in everyday language as inertia. Mass is measured in kilogram. It only has a quantity and no direction. The mass of an object will be the same anywhere in the universe.

Weight

All things are attracted to the earth. Objects fall because earth exerts a downward force on them. This force is called gravity. The force of gravity is the force of attraction between two bodies because of their masses. Thu,s the weight of an object is the force exerted on that object by gravity.

Weight = $Force_{gravity}$ = mass x gravity.
Gravity on earth is $9,8 m.s^{-2}$

The weight of a body is a force, and must be expressed in terms of the unit of force which in Newton.
Some interesting facts:

- The weight of an object will be less on the moon than on earth, as the moon's gravity is less than the one on earth. This is why moon walkers seem to float across the moon's surface.
- The weight of a given body varies by a few tenths of a percent from point to point on the earth's surface, partly because of local deposits of ore, oil, or other substances whose density differs from the average, and partly because the earth is not a perfect sphere but is flattened somewhat at the poles.
- The weight of a given body decreases inversely with the square of its distance from the earth's centre, and at a radial distance of two earth radii, for example, it has decreased to one-quarter of its value at the earth's surface.

Motion

Mechanics deals with the relations of force, matter and motion. Motion may be defined as a continuous change of position. In most actual motions, different points in a body move along

different paths. The complete motion is known if we know how each point in the body moves, so to begin we consider only a moving point, or a very small body called a particle.

Speed

Speed is a scalar quantity as the direction is not indicated in the unit. The equation for speed is:

$v = \Delta s/\Delta t$

This can also be written as follows:

speed = $\frac{\text{Distance}}{\text{time}}$

The triangle on the right allows you to do any calculation regarding speed, distance or time. D = distance, T = time and s = speed.

According to the triangle, s=D/t, D = s x t and t = D/s

Example:

Calculate the speed of a car if it travels 300 km in 2 hours.

S = D/t = 300km/2hrs = 150km/h

Calculate the distance a runner covers if he runs at 8km/h for 3 hours.

D = s x t = 8km/h x 3 h = 24km

Acceleration

When the velocity of a moving body changes continuously as the motion proceeds, the body is said to move with accelerated motion. The average acceleration of the body as it moves from P to Q is defined as the ratio of the change in velocity to the elapsed time.

$\bar{a} = \Delta v/\Delta t$

Example:

Calculate the average acceleration of a car if it can go from 1 to 100km/h in 10 seconds

$\bar{a}$ = 100km/h ÷ 10s = 10km/h/s i.e., the car accelerates 10 km/h every second.

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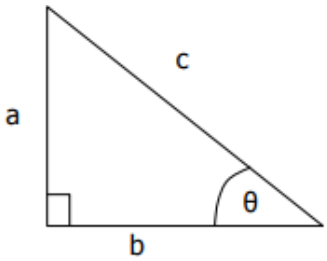
Calculating Heights and Distances

In the diagram below side c is called the hypotenuse. The hypotenuse is always the side opposite the 90° angle.

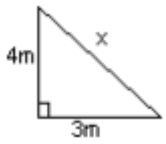
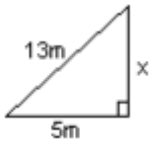


Pythagoras' theorem states the following for a right-an

In words, Pythagoras' theorem states: In a right-angled triangle the sum of the squares of the shorter two sides is equal to the square of the hypotenuse.

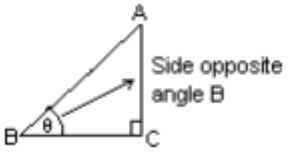
Example:

Calculate the size of the side marked x in each case.

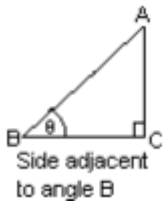
	$x^2 = 4^2 + 3^2 = 16 + 9 = 25$ $x = 5m$
	$x^2 + 5^2 = 13^2$ $x^2 + 25 = 169$ $x^2 = 169 – 25 = 144$ $x = 12m$

The sides of a right angles triangle can also be seen in relation to the other angles:

Side AC lies opposite angle B.

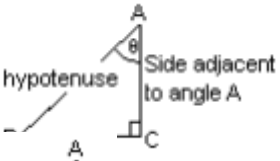


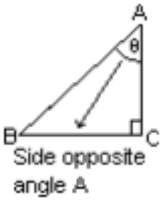
Side BC lies adjacent (next to) angle B



Notice that there are two sides adjacent to angle B: s BC. We do, however, already know that side AB is the hypotenuse. So only si djacent".

Side AC lies adjacent to angle A.



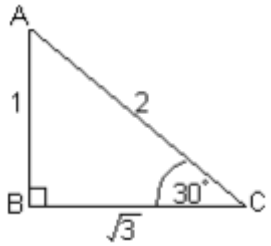


Side BC lies opposite angle A.

Trigonometry laws are as follows:

sin θ = opposite/hypotenuse cos θ = adjacent/hypotenuse tan θ = opposite /adjacent	The trigonometric ratios must be learnt. Learning tip: Remember this silly rhyme. The first letters of each word help you to remember. **S**ome **O**ld **H**ags **C**ackle **A**nd **H**aggle **T**ill **O**ld **A**ge

In triangle ABC, we can work out the three trig ratios.



Sin 30° = o/h = ½ = 0,5

Cos 30°= a/h = √3/2 = 0,867

Tan 30°= o/h = 1/3 = 0,33

Now use a scientific calculator and work out sin 30°. You get 0,5.

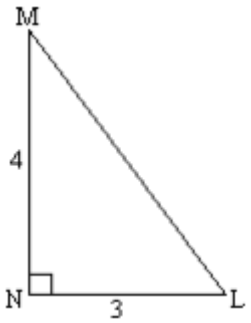
(key sequence on calculator: sin 30 =)

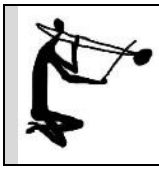
Work out cos 30°and you get 0,867

Work out tan 30°and you get 0,33.

These trigonometric ratios can be used to work out sides and angles of right-angled triangles.

Example:

	**Work out all the missing sides and angles in the triangle MNL** a) Work out the hypotenuse by using Pythagoras. ML = 5 b) Work out angle L by using Trig Sin L = o/h = 4/5 = 0,8 L = 53,13° (key sequence on calculator: 2nd function sin 0,8) c) Work out angle M by using the fact that angles of a triangle add up to 180° M = 180° – 90° – 53,13° = 36,87°

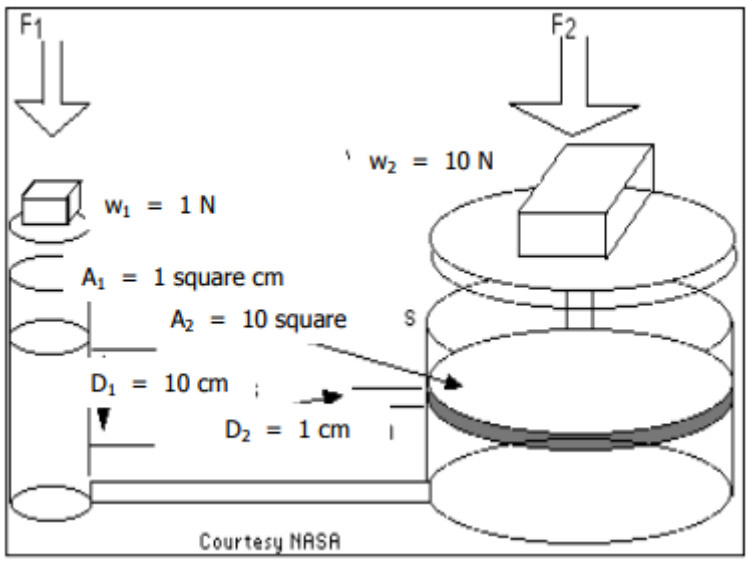


Individual Activity 5

Hydraulic Jacks

Hydraulic jacks and many other technological advancements such as automobile brakes and dental chairs work on the basis of Pascal's Principle, named for Blaise Pascal, who lived in the seventeenth century. Basically, the principle states that the pressure in a closed container is the same at all points. Pressure is described mathematically by a Force divided by Area. Therefore, if you have two cylinders connected together, a small one and a large one, and apply a small Force to the small cylinder, this will result in a given pressure. By Pascal's Principle, this pressure would be the same in the larger cylinder, but since the larger cylinder has more area, the force emitted by the second cylinder would be greater. This is represented by rearranging the pressure formula P = F/A, to F = PA. The pressure stayed the same in the second cylinder, but Area was increased, resulting in a larger Force. The greater the differences in the areas of the cylinders, the greater the potential force output of the big cylinder. A hydraulic jack is simply two cylinders connected as described above.

An enclosed fluid under pressure exerts that pressure throughout its volume and against any surface containing it. That's called 'Pascal's Principle', and allows a hydraulic lift to generate large amounts of FORCE from the application of a small FORCE.



Assume a small piston (one square cm area) applies a weight of 1 N to a confined hydraulic fluid. That provides a pressure of 1 N per square cm throughout the fluid. If another larger piston with an area of 10 square cm is in contact with the fluid, that piston will feel a force of 1 N/ cm2 x 10 cm2 = 10 N. So, we can apply 1 N to the small piston and get 10 N. of force to lift a heavy object with the large piston. Is this 'getting something for nothing'? Unfortunately, no. Just as a lever provides more force near the fulcrum in exchange for more distance further away, the hydraulic lift merely converts work (force x distance) at the smaller piston for the SAME work at the larger one. In the example, when the smaller piston moves a distance of 10 cm it displaces 10 cubic cm of fluid. That 10-cubic cm displaced at the 10-square cm piston moves it only 1 cm, so a small force and larger distance has been exchanged for a large force through a smaller distance.

House plan

According to the requirements for this unit you need to be familiar with the reading and analysis of house plans.

	**Individual Activity 6**
	**Individual Activity 7**
	**Individual Activity 8**
	**Individual Activity 9**

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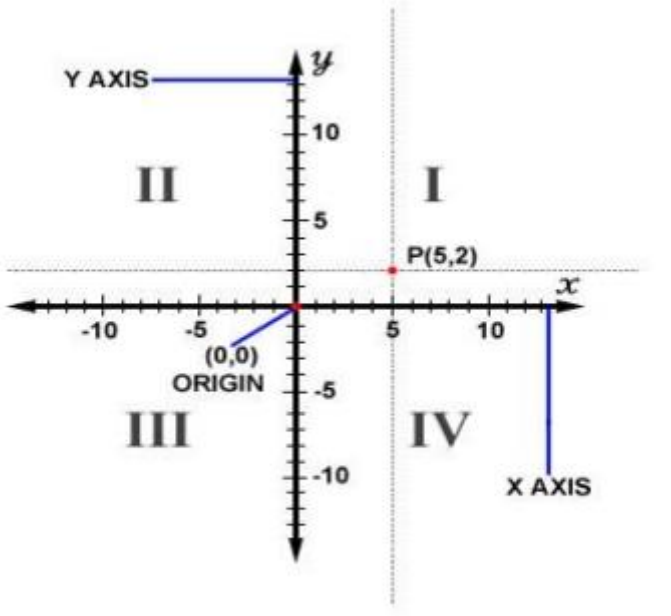
Cartesian Co-ordinate System

The graphs that you have drawn in previous years are always drawn on a set of axes. These axes have the fancy name of "Cartesian co-ordinate system" and the whole graph is known as a Cartesian plane. The Cartesian co-ordinate system consists of two axes: the horizontal X axis and the vertical Y axis. The X and Y axes cross at 900 at the point zero. This point is also known as the origin.

One can also draw three-dimensional graphs. In this case there are 3 axes: the X, Y and Z axes. The Z axis provides a third dimension in space. We shall, however, only work with X and Y axes. To specify a particular point on a two-dimensional coordinate system, you indicate the x unit first (abscissa), followed by the y unit (ordinate) in the form (x,y), an ordered pair. In three dimensions, a third z unit is added, (x,y,z).

The choices of letters come from the original convention, which is to use the latter part of the alphabet to indicate unknown values. The first part of the alphabet was used to designate known values.

Example:
An example of a point P on the system is indicated in the picture below using the coordinate (5,2).



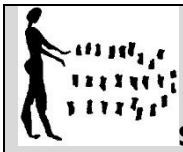
2 DIMENSIONAL CARTESIAN COORDINATE SYSTEM

The arrows on the axes indicate that they extend forever in the same direction (i.e., infinitely). The intersection of the two x-y axes creates four quadrants indicated by the roman numerals I, II, III, and IV.

Conventionally, the quadrants are labelled counterclockwise starting from the northeast quadrant. In Quadrant I the values are (x,y), and II:(-x,y), III:(-x,-y) and IV:(x,-y). (See table below)

Quadrant	X values	Y values
I	> 0	> 0
II	< 0	> 0
III	< 0	< 0
IV	> 0	< 0

Individual Activity 10



SUMMATIVE 3B

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Unit 4: Natural Resources Management

Natural Resource Management Plan

Unit Standard	
116303	Implement a natural resource management plan
Specific Outcomes	
SO 1: Assess the efficiency of the routine natural resource management practices and/or applications on the farm. SO 2: Select and apply (from a range of preventative and/or rehabilitation measures) the most appropriate to the specific regional/local context. SO 3: Contribute to strategic planning in terms of natural resource management as relevant to the farm. SO 4: Schedule activities related to alien eradication, erosion control, seasonal and climatic conditions, and use of natural resources.	
Learning Outcomes	
Identifying	Working Organise

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NATURAL RESOURCE MANAGEMENT

Natural resource management practices

Natural resources are the soil, vegetation and water that needs to be managed in such a way that it is preserved for generations to come. This management of natural resources can be done in different ways to ensure the sustainable use thereof. The main focus must be to utilise natural resources in such a way that it can be preserved for the next generation and that it is used in a sustainable way to ensure continuous production.

What do we mean by Natural Resource Management Practices?

Natural resource management is the management of soil, vegetation and water to rule out damage and that its use will be available for the next generations.

Human interference in the development of ecosystems is widespread. Farming, for example, is the deliberate maintenance of an immature ecosystem, one that consists of few species (sometimes only one), highly productive but relatively unstable.

Sound management of ecosystems for optimal food production should seek a compromise between the characteristics of young and mature ecosystems and should consider factors that affect the interaction of natural cycles.

Short-term production can be maximised by adding energy to the ecosystem in the form of cultivation and fertilisation. These efforts, however, can delay efficient energy use in the long run by producing an imbalance of nutrients, an increase in pollutants or an increased susceptibility to plant diseases as a consequence of intensive inbreeding of crops.

During the second half of the 20th century the study of ecosystems has become increasingly sophisticated and is now instrumental in the assessment and control of the effects of agricultural development and industrialisation on the environment. On farms, for instance, it has been proved that optimal long-term production of pastures requires a moderate grazing schedule. Moderate grazing ensures a steady renewal of the moisture and nutrient content of

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the soil. This has emphasized the need for multiple-use strategies in the cultivation of arable lands.

The process of orderly replacement of one ecosystem by another is known as ecosystem development or ecological succession. Succession occurs when living organisms colonises a sterile area, such as barren rock or a lava flow, or when an existing ecosystem is disturbed, (e.g., when a forest is destroyed by a fire) and recolonised after the destructive event. The succession of ecosystems generally occurs in two phases. The early, or growth, phase is characterised by ecosystems that have few species and short food chains. These ecosystems are relatively unstable but highly productive, meaning that the build-up process of organic matter is faster than the break-down process.

Ecosystems in the later, or mature, phase are more complex, more diversified and more stable. The final, or climax, ecosystem is characterised by a great diversity of species, complex food webs and high stability. The major energy flow has shifted from production to maintenance. Climax ecosystems tend however to be sensitive to disrupting events.

Ecology systems are concerned with the consequences of accumulated **insecticides** and have provided a way of monitoring the climatic effects of atmospheric dust and **carbon dioxide** released by the burning of fossil fuels (e.g., coal, oil, and natural gas). It helped to determine regional population capacities and promoted the development of recycling techniques that may become essential in humanity's future interaction with the environment.

The most direct impact of humans on ecosystems lies in the destruction or conversion thereof. Clear-cutting (the cutting of all trees within a given forest area) will, obviously, destroy a forest's ecosystem. Selective logging may also alter forest ecosystems in important ways. Fragmentation or the division of a once continuous ecosystem into a number of smaller patches may disrupt ecological processes so that the remaining areas can no longer function as they once did.

Climate Change

It is now widely accepted that humanity's activities are contributing to global warming, mainly through the accumulation of "greenhouse" gasses in the atmosphere. The impact of this is likely to increase in the future. Climate change thus, is a natural feature of the Earth. In the

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past its effects were eased as ecosystems could effectively "migrate" by moving latitude or altitude as the climate changed. Today, however, there is no suitable place for the remaining natural or semi-natural ecosystems to 'migrate' to.

Contamination of the natural environment due to a range of pollutants including herbicides, pesticides, fertilisers, industrial effluents and human waste products, is one of the most destructive factors on the natural environment. Pollutants are often invisible and the effects of air pollution and water pollution may not be immediately obvious, although they can be devastating in the long run.

Human beings have been responsible either deliberately or accidentally for altering the distribution of a vast range of animal and plant species. This includes not only domesticated animals and cultivated plants but also pests such as rats, mice and many insects and fungi. Species which became instinct may have had a devastating impact on natural ecosystems by means of predatory and competition.

Removal of excessive numbers of animals or plants from a system can cause major ecological changes. The most important example of this at present is the overfishing of the world's oceans. Reduction of the majority of easily reached fish stocks is undoubtedly a cause of major change, although its long-term impact is difficult to calculate.

Controlling human impact on ecosystems

Controlling the impact of man on ecosystems is probably the biggest challenge facing human beings in the coming millennium. Solutions will have to be found at all levels, locally and global.

Protection of remaining natural ecosystems in national parks and other protected areas is crucial. However, this will not prevent areas being affected by factors such as climate change and air- or water-borne pollutants. Moreover, as natural areas shrink in size, they are likely to require more and more active management to maintain their ecological functions, e.g. by means of controlling exotic species, manipulation of water levels in wetlands and periodic controlled burning of some forest habitats. Increased intervention of this kind will always be risky, as we still do not fully understand the workings of most ecosystems.

Controlling pollution and emission of greenhouse gasses will require action at a global level, as will efforts to prevent further deterioration of marine fisheries through over-fishing.

Ultimately, the solution lies in the control of human population growth and in a far more restrained approach to our use of natural resources and expenditure of energy.

Functions and values of wetlands

Wetland functions are physical, chemical and biological processes or attributes that are vital to the integrity of the wetland system. Wetlands are normally transition zones (eco-tones) between uplands and deepwater aquatic systems. The many processes that take place in them have a global impact: - they can affect the export of organic materials or serve as a basin for inorganic nutrients. This intermediary position is also responsible for the biodiversity often encountered in these regions as wetlands "borrow" species from nearby aquatic and terrestrial systems. Wetlands play a major role in the biosphere by providing habitats for a great abundance and richness of flora and fauna species; they are also the last havens for many rare and endangered species.

Some wetlands are considered among the Earth's most productive ecosystems. The wetland's function as a site of biodiversity is also valuable to humans. Wetlands also have the capacity to absorb great quantities of water - benefits developed areas. A wetland system can protect shorelines, cleanse polluted waters, prevent floods and recharge groundwater activities, earning wetlands the name of "kidneys of the landscape."

As a natural resource, soil in turn, is also a combination of living and nonliving components: it consists of atmospheric gasses, water, living and dead organic materials and delicately separated mineral substances. Moreover, soil is a product of the interaction between the living and the nonliving environment. The living components of soil are the renewable resources within the limitations that already have been noted and the mineral components are the non-renewable resources. As long as the living components of soil remain healthy and continue to function, the mineral components are recycled from the soil by means of organic life within (e.g., bacteria and other micro organisms) and back to the soil following the decay and breakdown of dead organic materials. As most forms of terrestrial life dependents on these for their continued existence, soil must be maintained in. Mining soil is normally low in fertility. It is therefore unlikely that life can continue to exist in an area flooded with this soil.

After reading through the above section on ecosystems and the interaction of food chains we will realise that there is still a lot of learning about natural resource management that will have to be studied and put in place if we want to try and maintain a balance in the future.

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In the past there was a balance in the ecosystem and it could respond to the effects of grazing by the natural fauna of the area.

For example: browsers, such as kudu, giraffe and black rhino are located in bushy areas as they feed on scrubs and bushes. The impact by these animals was huge and the mere presence ensured that the scrubland was restricted to limited areas of the greater ecosystem. A balance was obtained as the number of browsers present was determined by the carrying capacity of the land. This balance did change as times of drought and fire affected areas.

The larger animals, elephants and rhinos, would have trampled the grazing and delicate ground covering but its occurring numbers would not have had a long term impact on the grazing or plants found in the area.

Game such as Impala and Springbuck, together with larger animals such as eland, buffalo and zebra will be found on plains (areas with natural grass) as they are grazing animals The larger animals are bulk grazers, thus eating the long grass while the smaller animals, consuming less vegetation, will eat the shortened grass and even different grass species and ground coverings. The occurrence of food was more of a control factor on the size of populations than the occurrence of natural enemies.

Many grass species have evolved the ability to tolerate high levels of grazing, which is evident to anyone who regularly mows a lawn. Simultaneously, they have evolved other defences, such as high silica content, which reduces their palatability to some grazers. A number of herbivorous mammals have responded to these defences by evolving the ability to specialise on grasses with high silica content and low nutritional value.

Large grazing mammals such as elephants have high-crowned teeth that are constantly replaced by growth as the crowns are worn down by the silica in their food. Many of these species also have complicated digestive systems with a gut full of micro flora and micro fauna capable of extracting many of the nutrients from the plants.

Plants have evolved more than 10,000 chemical compounds that are not involved in primary metabolism and most of these compounds are thought to have developed as defences against herbivores and pathogens.

Some of these chemical compounds are defences against grazers, whereas others are defences against parasites. Most of the chemical compounds that make herbs so flavourful and useful in cooking probably evolved as defences against enemies.

These compounds, called allelo chemicals, are found in almost all plant species and their great diversity suggests that chemical defence have always been an important part of plant evolution.

Before the intervention of mankind, taking control on earth, the ecosystem was balanced and sustainable. The ecosystem that we have today is a result of the impact that we as humans have on the environment. Humans have changed and impacted on the local environment. A lot of the changes occurred because we wanted to control and manipulate the environment while other changes occurred because of ignorance.

Individual Activity 1

Veld types

Natural veld in South Africa can be divided into sweet, sour and mixed veld. These veld types differ mainly in the nutrient value and the palatability of the common grasses during the dormant season when the plants are not growing.

Nutrient value – the quantity of nutrients that a plant contains at a specific stage.
Palatability – the tastiness of food as experienced by animals.

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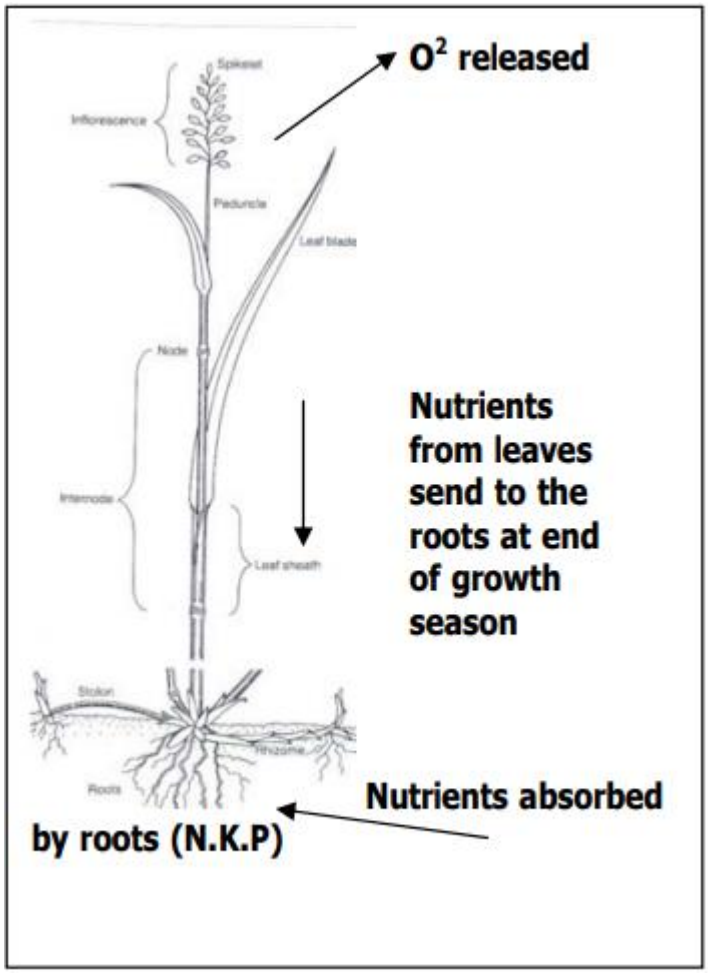
Translocation of nutrients – the movement of nutrients from the plant's roots to the leave base to survive during its growth period.

Climatic factors such as rainfall and temperature plays a major role in the environment regarding the adoption of plant species.

High rainfall areas - plant nutrients are leached from the soil, causing soil low in pH and fertility, with the result of a sour veld.

The severe winter with frost is typical of the sour veld area and plants adapted to the frost by translocation the nutrients from the leave-base, back to the roots.



Sweet veld occurs in the lower rainfall areas where only a small amount of nutrients are leached out of the soil during the rainy season. The plants in the sweet veld do not

translocation the nutrients to the roots as the temperature is usually higher than in the sour veld areas.

Characteristics of sweet, sour and mixed veld

Sweet veld

- Occurs mainly in the lower laying frost free areas
- Rainfall usually range from 250 – 500 mm per annum
- Most grasses remains palatable throughout the year, provided that the veld is in a good condition.
- Is sensitive to overgrazing during the growth season
- Recovers quickly after been grazed, provided that growing conditions is optimum.

Sour veld

- Is found at higher altitudes with lower temperatures
- Rainfall 625 mm per annum and more
- Produce palatable grazing with a fairly high nutritive value during the growth season
- Can withstand overgrazing but resulting to lower production
- Recovers slower from utilisation than sweet veld

Mixed veld

- Intermediary form between sweet and sour veld
- Characteristics similar to that of sweet veld - known as sweet mixed veld
- Characteristics similar to that of sour veld - known as sour mixed veld

The different veld types must be managed differently to utilise the veld when it is at its best with the highest nutritive value and palatability

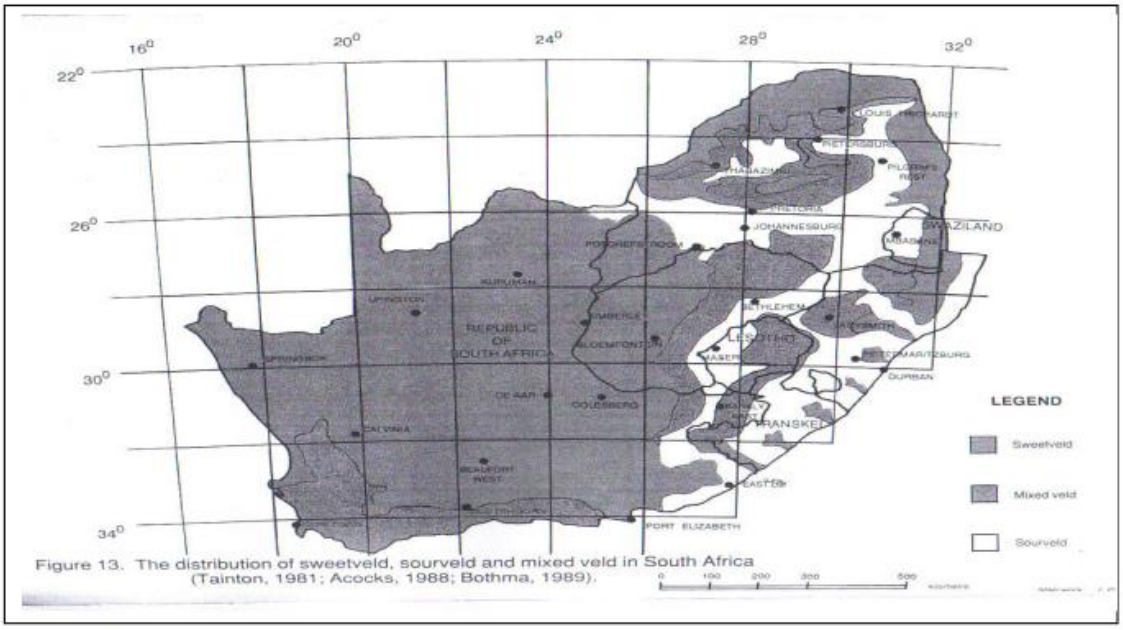


Figure 13. The distribution of sweetveld, sourveld and mixed veld in South Africa (Tainton, 1981; Acocks, 1988; Bothma, 1989).

	**Individual Activity 2** **Individual Activity 3**

Ecosystems - biomes

The study of ecosystems are based on the view that all the elements of a lifesupporting environment of any size, whether natural or man-made, are parts of an integral network in which each element interacts directly or indirectly with all others and affects the function of the whole.

All ecosystems are contained within the largest system known as the ecosphere, which includes the entire physical Earth (geo-sphere) and all of its biological components (biosphere).

An ecosystem is a combination of biotic components – living elements and a-biotic - non-living elements which include minerals, climate, soil, water and sunlight.

The a-biotic and biotic systems are linked by two major forces:

- The flow of energy through the ecosystem; and
- Cycling of nutrients within the ecosystem.

The fundamental source of energy in almost all ecosystems is energy captured from the sun. The ecosystem's autotrophic (self-sustaining) organisms (found in green vegetation) are capable of photosynthesis as they use sunlight energy to convert carbon dioxide and water into simple, energy-rich carbohydrates.

The autotrophic organisms use the energy, stored within the simple carbohydrates, to produce the more complex organic compounds, such as proteins, lipids and starches that maintain the organisms' life processes. The autotrophic segment of the ecosystem is commonly referred to as the producer level.

Organic matter generated by autotrophic organisms, directly or indirectly, sustains heterotrophic organisms. Heterotrophic organisms are the consumers of the ecosystem; they cannot make their own food. They use, rearrange and ultimately decompose these complex organic materials built up by the autotrophic organisms. All animals, fungi, most bacteria and many other micro organisms are heterotrophic organisms.

As a combination, the autotrophy and heterotrophy will form various strophic (feeding) levels in the ecosystem:

The producer level – a combination of autotrophic organisms which manufactures their own food;

The primary-consumer level – a combination of organisms that feed on producers;

The secondary-consumer level: – a combination of those organisms that feed on primary consumers.

The movement of organic matter and energy from the producer level through various consumer levels makes up a food chain.

For example: - a typical food chain in grassland might be grass (producer) → mice (primary consumers) → snake (secondary consumer) → hawk (tertiary consumer). Actually, in many cases the food chains of the ecosystem overlap as well as interconnect to form what ecologists call a food web. The final link in all food chains is made up of heterotrophy decomposers that break down dead organisms and organic waste.

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A food chain in which the primary consumer feeds on living plants is called a grazing pathway. If the primary consumer feeds on dead plant matter, it is known as a detritus pathway. Both pathways are important in accounting for the energy budget of the ecosystem.

As energy moves through the ecosystem, much of it is lost at each tropic level. For example, only about 10 percent of the energy stored in grass is incorporated into the body of a mouse that eats the grass. The remaining 90 percent is stored in compounds that cannot be broken down by the mouse or is lost as heat during the mouse's metabolic processes. Energy losses of similar magnitudes occur at every level of the food chain; consequently, few food chains extend beyond five members (from producer through to decomposer) because the energy available at higher atrophic levels is too low to support further consumers.

The flow of energy through the ecosystem drives the movement of nutrients within the ecosystem. Nutrients are chemical elements and compounds necessary to living organisms. Unlike energy, which is continuously lost from the ecosystem, nutrients are cycled through the ecosystem, oscillating between the biotic and a-biotic components in what are called biogeochemical cycles. Major biogeochemical cycles include the water cycle, carbon cycle, oxygen cycle, nitrogen cycle, phosphorus cycle, sulphur cycle and calcium cycle. Decomposers play a key role in many of these cycles as nutrients are returned to the soil, water or air where the biotic elements of the ecosystem can again use them.

An ecosystem is a system of living organisms that lives together and influences each other in different complementary ways, symbiotic or parasitic.

The ecosystem is divided into different biomes. A biome is formed by the influence of climate on living and non-living organisms of a specific region and by the adaptation of the vegetation (plants) to these climatic conditions

Biomes can be defined as- the largest land community which is characterised by the uniformity of the general climax vegetation. In the grassland biome, grasses are characteristic but the dominant species may vary from area to area. A biome does not only consist of vegetation, but also includes living organisms that find a suitable habitat with in. In South Africa six different biomes are recognised.

- Forest biome
- Thicket biome
- Savannah biome
- Grassland biome
- Namma Karoo biome
- Succulent karoo biome
- Fynbos biome

The characteristics of these biomes are the following:

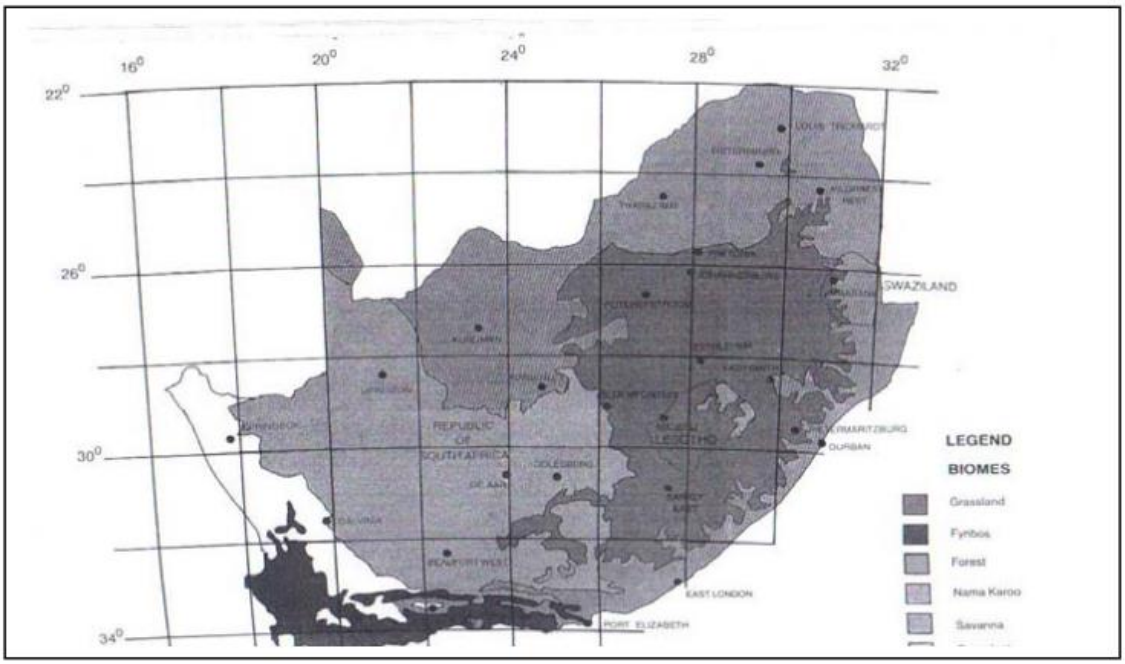
	Biome	Characteristics
1	Forests	800- 1000mm rain through out the year. Large forest area. Summers are worm with mild winters. Knysna in Western Cape, the. Eastern Cape and KZN. In certain areas trees are planted in plantations for wood production, KZN, Easter Cape, Western Cape, Mpumalanga and Limpopo
2	Thicket	Evergreen scrubs and small trees - not tall enough for forestry - with little grass. Falls between a forest and a savannah biome. Rainfall in summer up to 1000mm per annum
3	Savannah	Mixture of grassland and trees, 650 – 1000 mm rainfall annually , mainly during the summer Bush veld area of the country and parts of North West province, Northern Cape, KZN and Eastern Cape
4	Grassland	Large areas with grassland, rainfall from 400-800mm during the summer. Summer temperature hot with cold winters and frost. Free State , Mpumalanga –high veld, North West and KZN
5	Nama Karoo	Mixture of grass and scrubs with annual rainfall of 400 mm per year. Very hot summers and cold winters with frost. (Semi desert area)
6	Succulent Karoo	Large areas of succulent plants, scarce grass cover; rainfall 20 – 250 mm per year during the winter. In spring time large areas with beautiful veld flowers. Summers very hot and winters mild with no frost
7	Fynbos	Scrubs, grass and plants with narrow leaves; in the mountainous area for the Western Cape. Rainfall during the winter 400 –1200 mm per annum. Summers hot and winters cold and wet with frost in the higher areas.

Grazing value and ecological status of veld

In the early days when game roamed freely on the grasslands of South Africa there was no overgrazing as the game moved from one area to another and the different animals use the grazing differently. As it was explained earlier in this chapter, the animals use the natural vegetation at different levels and select the different parts of the plants. This creates a balance in the vegetation.

In the course of time the natural feeding areas of game was invaded by mankind. Game had to make way for increasing farm activities such as cattle, sheep and goats, which fortunately, also preferred different parts of the vegetation - Cattle preferred long grass while sheep preferred short grass.

With the fencing off of farms, the movement of animals are restricted, allowing (force?) over grazing of a specific camp or area if they are not moved in time. The selection of animals can be used as indicator for veld management. The aim of this section is to result in an understanding of the value of natural veld and vegetation. There must be a balance between the natural veld and the number of animals kept on the specific area.



Management practice scheduling

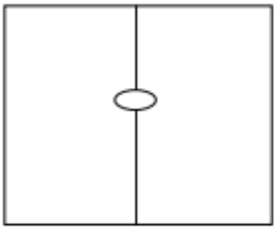
Veld management refers to the management of natural vegetation for specific objectives related to different forms of land use. The objective of veld management is the sustained production of livestock products thought the maintenance of the veld in a stable and productive condition) "(van Oudtshoorn p45)

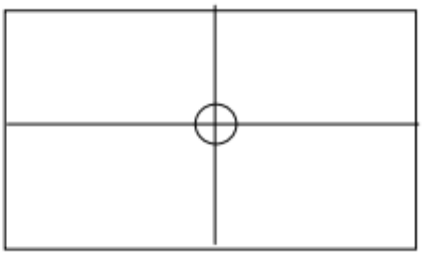
Veld management comprises of three components – veld management practices, systems and layout. Different camp layout systems can be used and different rotational grazing systems can be used. Various researchers have different ideas about the correct grazing system. The farmer must establish the best system for his farm and stick to it. The best system will be the one that ensure maximum animal production without detrimental effects on the natural grazing

A Veld management practice is a formal program through which veld management practices are applied and refer to the number of camps allocated to a group of animals and includes the following valid actions:

- Stocking rate
- Animal ratio
- Rotational grazing
- Rotational resting and
- Burning of veld

A layout is the arrangement of the different camps in the veld management system. These layouts can either be in a conventional arrangement or in a wagon wheel arrangement. A conventional layout is where the veld is divided into homogeneous vegetation units from where a multi camp system is formed with four, six or eight camps. Each camp is normally provided with drinking thought. Two or four camps can also share a drinking trough.





Wagon Wheel camp layout system

The advantages of the wagon wheel system are:

- The ease with which livestock and veld can be managed by just opening and closing of gates.
- Reduce the cost of infrastructure such as water points
- Animals can be collected at a central point
- Saving in labour costs for the collection and working with the animals

The disadvantages of this system are:

- Greater possibility for area selection by the livestock as vegetative types are not separated.
- Suitable for flat areas only
- It can contribute to soil erosion with the animals' footpaths
- The wagon wheel system requires more fencing

The advantages of the wagon wheel and the conventional systems can be combined to obtain maximum benefit e.g. minimum input costs - fencing, water provision (reservoirs, boreholes and pipelines) etc.

Monitoring of management practice

Rotational grazing and resting are management practices that can be used to improve the quality of veld. Rotational grazing - animals are rotated between the different camps at pre-determined intervals enabling a camp to 'recover' while the next camp is utilised, thus preventing the simultaneously grazing of the whole veld. The main objective of veld rotation is the improvement or maintenance of the veld condition.

Two forms of rotational grazing can be used

High production grazing (HPG)		High utilising grazing (HUG)
The utilisation of a camp by grazing animals until all the acceptable and desirable grass species have been grazed to a stage where rapid re-growth and production of forage will still occur (Tainton, 1981)		Occupation of the grazing camp by grazing animals until all the grass species have been heavily grazed (Tainton , 1981)
The use of the different types of rotational grazing will depend on The condition of the veld The dominance of different indicator species – Decreasing or increasing		
Different classes of grass	Description	
Decreasing species	These grass species will dominate a veld in a good condition but will decline in numbers as the veld deteriorates.	
Increaser I species	This specie is not abundant in a veld in a good condition, but will increase when the veld is under utilised.	
Increaser II species	This specie is not abundant in a veld in a good condition, but increase when the veld is over -utilised	
Increaser III species	This specie is not abundant in a veld in a good condition but will increase when veld is selectively grazed	
FORMS OF ROTATIONAL GRAZING		
High production grazing HPG ←	HPG → ← HUG	→ High Utilisation grazing HUG
Pioneer stage	Plant succession → Strive to reach the stage climax	Climax stage
Increaser II	'Decreasing'	Increaser 1
Dominant species.		

Rotational resting

Rotational resting is the successive withdrawal of grazing from a veld for a period of time on a rotational basis for a specific purpose.

The aims of rotational resting are:

- Allow the grass to form seed
- Restoration of plant vigour
- Allow a plant to provide fodder reserves for the winter – standing hay.

Application of Rotational resting		
→	Seeding rest a priority when decreasing species declined	←
	Rest to restore plant vigour Sweet veld to be rested for a full year Mixed and sour veld rested for short period - late summer or autumn	
	One third (1/3) of sweet veld to be rested annually One quarter (¼) of sour veld areas	
Increaser II	'Decreasing'	Increaser I

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Burning of veld

Burning the veld is an important and often essential veld management tool in both livestock and came farming. The season in which the veld is burnt is the most important factor to be considered in a burning program

Veld is burnt to:

Remove the unacceptable grass and unused material

To eradicate or prevent bush encroachment

The following need to be taken into account when burning a veld:

- Type of fire
- surface fires
- Head fires burns with the wind. Head fires are recommended as they cause less damage to plants and trees.
- back fires that burn against the wind
- Fire intensity - Do not burn if the wind speed exceeds 20 km/h - cool fire, with low intensity fires that can be used to remove excess material or unwanted material , burning should take place when air temp is lower than 20°C
- Season of burning: Veld should be burned during the last part of winter when the grass is dormant or the beginning of spring, just before the first spring rains starts to fall.
- Frequency of burning. On sour veld the frequency of burning should be every 2 – 4 years ,depending on the quantity of unused plant material
- Post fire grazing management .Grass must have sufficient time to recover; therefore only short grazing periods (one week) are allowed in a rotational program.

Natural resource management practices

The sustainable management of natural resources (land, water, marine and biological systems) is vital if we want to ensure our ongoing social, economic and environmental well-being. It is also the only way that we will be able to produce enough food for the population.

Natural resource management practices: these are defined plans and strategies that must be implemented and the goals and contributions thereof must be accept by all parties and catchments' activities addressing a range of Natural resource management issues that includes:

- land and water management

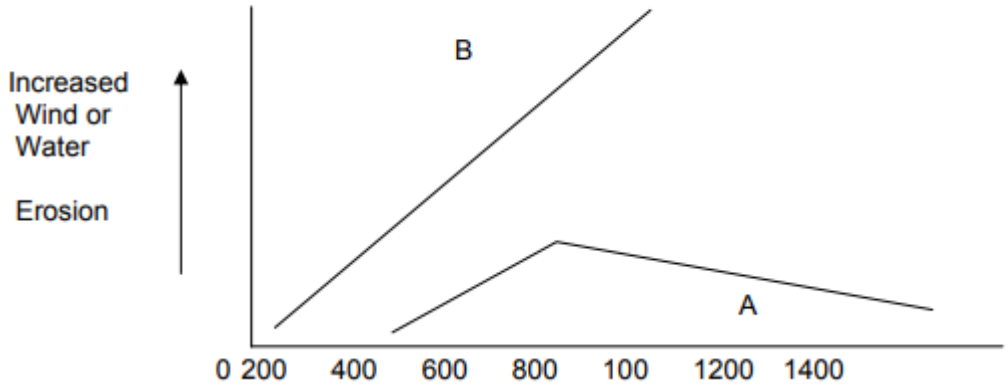
- biodiversity
- agricultural practices

Erosion management

Erosion is the removal of weather-beaten soil material from a site and deposited elsewhere to form or change the landscape.

Erosion takes place in two ways: the slow process or natural erosion and the accelerated erosion that occurs where the natural equilibrium had been disturbed. This type of erosion occurs when the protective cover of natural vegetation was removed or destroyed. The result of this type of erosion is loss of productive soil and reduction of soil productivity over the long run.

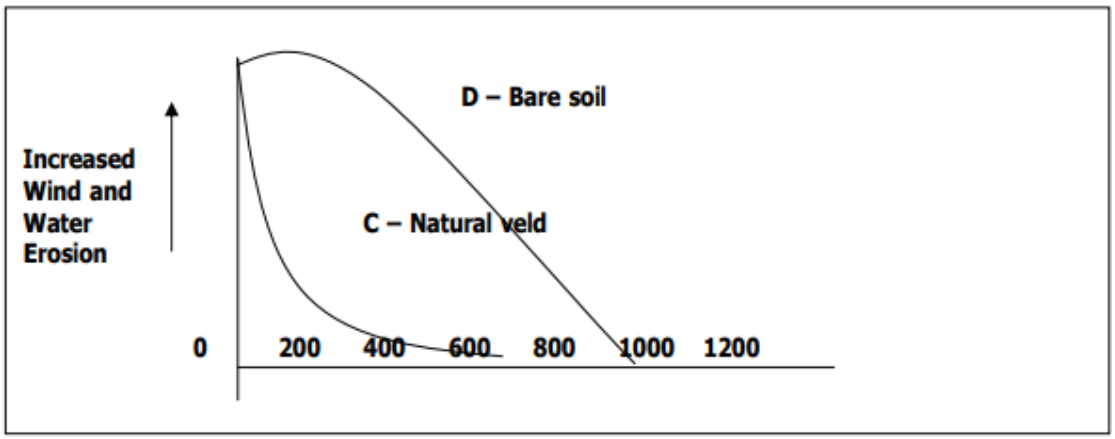
There is an important relation between water and wind erosion, vegetative cover and annual rainfall. Water erosion increases with the increasing of annual rainfall, on natural veld as well as on bare soil. The effect of water erosion is much higher on the bare soil as on a veld with natural vegetation.

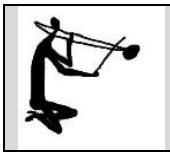


Line A represents natural veld and shows the increasing of water erosion from dry to wetter conditions.

Erosion decreases when rainfall and vegetation covering increases. Line B reflects water erosion on bare soil and clearly shows its increasing with the quantity of rainfall Wind erosion is a problem in the drier or more arid land areas. Natural vegetation management is very important as the natural veld covering reduces the effect of both wind and water erosion - see

following graph where D represents the effect of wind erosion on bare soil and C represents the effect of wind erosion on natural veld in the more arid land areas.





Individual Activity 4

Individual Activity 5

Causes of soil erosion

- Increasing pressure of land resources.

As the population grows, so do the needs grow for more food, housing and infrastructure? The demand for housing and infrastructure unfortunately takes up agricultural land, thus decreasing the production area while the need for food increases.

The result can be seen on both crop and animal production.

The natural veld and resources are pressurised by the increasing of animals which must provide for the daily needs. The increasing animal population is detrimental to veld management - over grazing can cause erosion as the natural veld covering is reduced.

In the case of crop production, the farmer is now forced to use areas normally not suitable for cultivation - water erosion increases on the bare soil.

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- ❖ Economic influences

Because of unrealistic prices for products and land – due to demand and supply - the farmer is propelled to produce more and more. The natural resources cannot support the extra production burden – yield\ha is limited – he is therefore forced to use low producing soil where sustainable systems – erosion – can not be applied. Factors such as profit margins and increasing input and labour costs also add to this compulsory extension plan.

- ❖ Incorrect farming systems

Farming systems, not taking the natural resources into account, will result in over grazing and bare areas where the soil is exposed to water erosion. The over exploitation of crop land and grazing in certain areas of the land is very detrimental. New farmers or communities are placed on productive farms not knowing the soil- or veld type, thus resulting in the neglect of sustaining natural resources.

- ❖ Lack of knowledge and expertise

New farmers or communities that get land through various government schemes or land restitution do not have the knowledge to use the natural resources correctly. These new farmers need to be trained and assisted by the department of agriculture to be successful before the land is handed over to them. Communal farming systems used in the rural areas is also detrimental to the natural resources as there is no infrastructure to enclose animals resulting in over utilisation of the natural resources.

- ❖ Inadequate law enforcement

The laws regarding the preservation and care of natural resources are not enforced due to the lack of manpower or the lack of knowledge. The Department of Agriculture must fulfil its function regarding the maintenance and management of natural resources.

- Farm planning

Poor fences, lack of watering points, roads and preventative structures to stop erosion contribute to the problem of erosion. Poor construction of contours and water ways can cause mayor problems regarding water erosion in crop lands.

	**Individual Activity 6**

Management of natural resources

Lack of sound farm management and not attending the cause of resource degradation will reduce the sustainability of the farming enterprise.

Cultivation methods

By removing all the organic material from the field after harvest - nothing to slow down the flow of water – will ease erosion.

Different types of erosion

- ❖ Water erosion
- Splash-erosion

  The pounding action of raindrops on the surface causes two things; (a) When a raindrop, moving with a speed of about 20 km/h, strikes a bare unprotected area of soil the small soil particles are splattered over a distance due to the weight of the drop and the kinetic energy of the impact on the soil.

  (b) The thumping action causes the soil surface to seal off, thus reducing and\or preventing the uptake of the water which now increases the volume of runoff water.

- Rill erosion

  Rill erosion is the result of runoff water, caused by 'splash-erosion, which creates small channels from which soil particles are removed and in which other soil particles are transported.

- Gully erosion

  Gully erosion is actually the enlargement of rill erosion. In other words, as rill erosion becomes deeper with time, it is known as gully erosion.

- Terracette erosion

  This type of erosion normally occurs on steep slopes.

- Stream bank erosion

  This type of erosion occurs in streams where the banks are widened due to the action of fast flowing water.

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- Tunnel erosion

  Tunnel erosion is caused by water making tunnels in the banks of a stream and which collapses with time.

❖ Wind erosion:

  The wind moves soil in three different ways.

- Creep – soil roll on the earth's surface.
- Saultate - where the soil particles bounces into the air and land some distance away.
- Suspension – where soil is taken up into the moving air and blown away.

Wind erosion causes high soil losses on recently cultivated lands. Soil losses in natural low rainfall areas with skeletal vegetation can also be relatively high.

Factors effecting Erosion

- Rainfall erosion liability

Rainfall erosion liability is the potential of rainfall intensity combined with the kinetic energy of raindrops to cause erosion.

Erosion liability will increase in proportion to the intensity of rainfall - the energy generated from runoff water prevents the soil from absorbing water – runoff water ends up in dams or rivers. Soft rain on the other hand allows water to penetrate the soil and is thus of more value to the soil it self.

- Soil erosion liability

Soil erosion liability is the loss of soil per rainfall unit. This can be measured by measuring the soil losses from bare runoff plots subjected to natural or simulated rainstorms.

- The topography of the soil

The length and steepness of a slope will influence the runoff of water and the erosion accordingly. The steepness of a slope plays a bigger role in erosion than the length of a slope.

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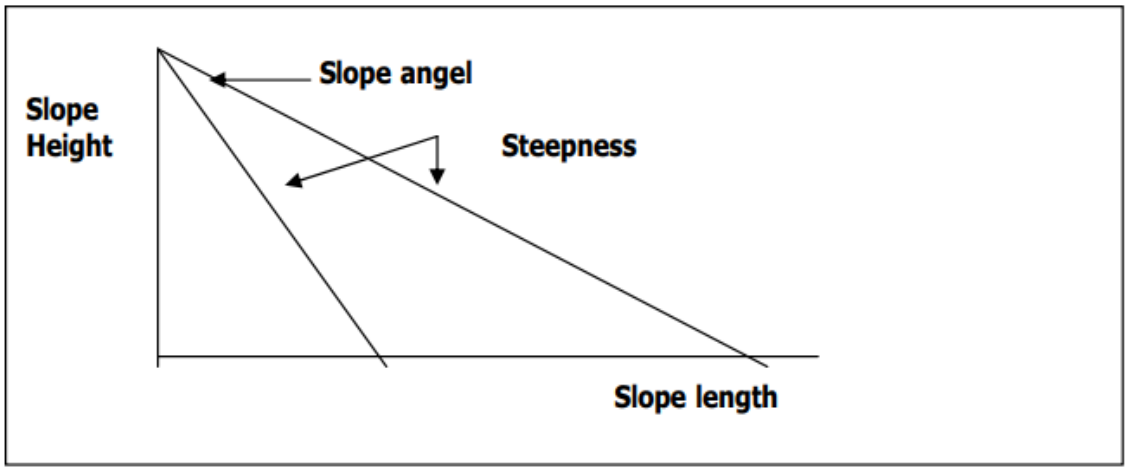

- Covering

Soil covered with natural vegetation, crops or stubble after harvest is very important to prevent erosion. Economic conditions, intensification of production, drought and poor management can result in the lack of ground covering, leaving the soil bare or with very little vegetative covering to prevent erosion when heavy rains are experienced. Covering is one of the larger factors that contribute to the prevention of erosion. The stubble or mulch covering on a land will reduce runoff of rainwater and prevent the seal off (splash erosion) action on the soil which in turn can have a negative effect on water absorption and seed germination.

- Management

Management and soil covering is the largest roll playing factors – it can either cause or prevent erosion. An effective management plan of natural veld and crop lands can reduce the effect of erosion dramatically. Severely damaged veld\lands must be withdrawn from grazing or any other kind of use for a period of time to allow it to recover naturally or by management inputs such as;

a) A structure need to be put in place to prevent further erosion and the slowdown of runoff rain water.

b) Control stocking rates and initiate proper grazing systems.

c) Veld\pastures must be burnt correctly – time and stage.

d) Application of veld improvement techniques.

e) Correct tillage or cultivation methods and plant density.

f) Maintenance of contours and waterways.

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Prevention and control of erosion

To control erosion there must be a joint action of infrastructure management and natural vegetation management.

To be successful, natural resources must be used and sustained by farming practices in such a way that it should:

- be in harmony with nature and the ecological factors
- not achieve high production at the cost of the natural resources
- and have a sound economic base.

A balance should be reached between soil formation and the soil loss. The farmer's aim should be to reduce soil loss to the minimum to ensure that the soil is kept productive and to save on repair costs to damages caused by erosion.

Farm planning is one of the most essential requirements for successful erosion control. The farm must be planned according to the available natural resources which include:

- Survey
- Assessment
- Planning
- Implementation
- Evaluation
- Maintenance of the infrastructure

In unit 11609 more detail is given on the whole farm planning matter.

Rehabilitation of damaged areas and the establishment of rehabilitation areas

To control runoff water the following basic principles need to be identified and applied:

- Natural watershed boundaries are respected
- Natural watercourses be recognised as such and should not be cultivated
- The planning of runoff disposal should start at the highest point in the catchment unless topographic conditions dictate other wise
- The construction of waterways should begin at the lowest point in the catchment area

Maintenance of catchments areas and the preserving of rain water

The catchments area of a dam can spread over very large areas or it can be a small confined area. The effect of water erosion on a dam - soil particles suspend in water is deposited in the dam - the dam loses its water holding capacity because of the build-up of silt on the dam's surface.

It is very important to ensure good ground covering in the catchment areas and that contour banks and waterways are in order to prevent erosion. These structures must be planned properly and maintained to ensure their correct function

Invasion of alien plants

Alien plants such as water hyacinth, black wattle and blue gum trees, as well as bush encroachment (in the bush veld) effects natural resources:

- The water hyacinth spread very easily and can cover large areas of a water system – pollutes the dams and reduce the amount of oxygen in the water.
- The water uptake of black wattle and blue gum trees from the soil is enormous, thus preventing other plants to grow underneath or nearby these trees – resulting in bare spaces where erosion can take place. These alien trees, when growing next to small streams where they use most of the water, can even stop the flowing of water. This again has an effect on the ecosystem. These alien trees must be removed and if necessary be replaced with indigenous trees.
- Busch encroachment –certain trees invades an area and prevents grass from growing amongst them (soil covering) because of strong competition. Because of these bare patches erosion may occur when heavy rain pours down.

Fire precautions

Farmers are forced by law to make fire breaks around their property to protect their property against veld fires – spreading from or into neighbour's veld. It is not always possible to protect the vegetation from accidental burning. In this case care should be taken to prevent immediate usage when new growth appears. The growth need to be at a certain length before the veld

can be lightly grazed. Allow rest periods enabling the grass plant to grow out and to build up reserves for future seed production.

Fire is used as a management tool e.g.

- To encourage the animal to move to different areas - in large game reserves,
- to control bush encroachment
- to control ticks
- to burn old grass and provide new growth for the animals.

Sustainable agricultural practices regarding natural resources:

To obtain sustainable use of agricultural- and natural resources, the aim will be to use these resources in a way to ensure that future generations will also be able to produce and enjoy the benefits from these resources. Sustainable use is not only a practice, but also an approach to ensure that the maximum production can be attained without the detrimental effect on the natural resources and the community.

Individual Activity 7

PREVENTATIVE REHABILITATION MEASURES

Evaluation of the deterioration and the route of deterioration

What is meant with deterioration?

Deterioration: Deterioration is a process of allowing natural recourses to break down to a stage where its production value is lost for ever. It is a negative process caused by various factors, thus the main reason why natural resource management need to be put in place.

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Rehabilitation measures

To overcome the effect of deterioration on e.g. natural vegetation, the implementing of rehabilitation measures need to be put in place to try and re-establish the natural vegetation to its natural form.

Rehabilitation measures may include the following:

- Rotate grazing allowing camps to rest.
- Establish new pastures – cultivate the damaged area to allow water absorption and encouragement of new growth - seed or seedlings.
- The construction of contour banks and water ways to prevent runoff of water.
- The improvement and maintenance of poorly maintained water structures.
- Build or construct barriers in damaged areas to prevent further damage and to slow down the runoff and flow of water.
- Crop lands can be rehabilitated by installing a draining system; add agricultural lime to soil to reduce the acidity and to prevent aluminium toxicity

The proper way to manage natural resources would be not to allow any damages but to ensure that the status of natural resources is kept at a level where rehabilitation is not necessary.

Important reasons for not allowing deterioration of natural resources:

- Rehabilitation costs - it will need additional inputs and cultivation.
- The loss of soil productivity – loss of income.
- Constructing costs - structures in damaged or eroded areas.
- Constructing and maintenance costs of new contour banks and waterways.
- Silt deposit of runoff water in dams - reduce the water holding capacity

Deterioration of veld or soil can be caused by the following

- Over grazing.
- Not allowing a camp to recover - no seedlings.
- Un-controlled burning of veld.
- Erosion.

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- Bush encroachment.

The deterioration of cultivated lands can be caused by the following:

- Mono cultivating – planting the same crop year-after-year.
- Over application of fertilisers.
- Over irrigation of soil.
- Build up of toxins in the soil.
- The lack of regular soil testing to determine the soil's nutritional status.
- The production system where fallow land is used (without fertilisers) until it is no longer fertile - then move to the next area, applying the same method – slash and burn system.

Topography, climate, vegetation and soil

The topography will influence the vegetation of that specific area because of the following reasons:

Temperature

- The heat units vary on the different slopes.
- The altitude above sea level; the-higher-the-colder and exposed to changing weather.
- The daily temperature in valleys is cooler than on the slopes or the plateau.
- The quantity sun light differs on the different sides - the shady side of the area will be cooler than the northern side which is exposed to direct sunlight the whole day.
- Vegetation will vary due to the quantity of shade or temperature - trees do not grow at high altitudes but natural forests occur at definite temperature zones.
- Northern slopes will be drier than southern slopes due to different sunlight hours and temperature.

Sunlight

- The quality of sunlight varies with altitude – intensity of ultra violet radiation increases at higher altitudes.
- The incoming radiation increases northwards during winter.

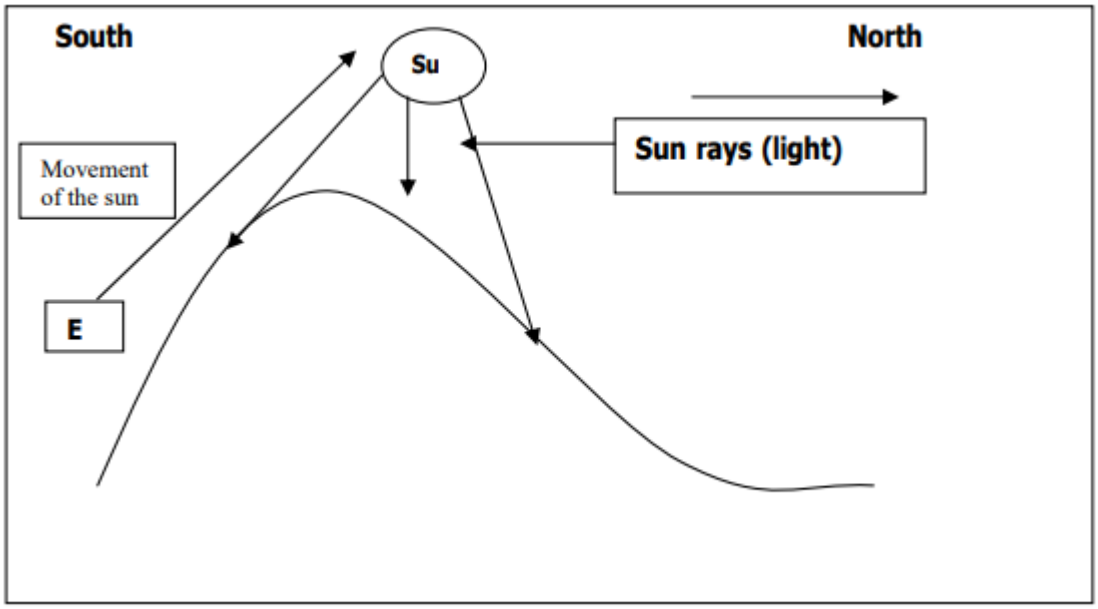
- Shade tolerating plants grow on the southern slopes and sunlight tolerating vegetation on the northern slopes.
- Sunlight penetration is poor in areas with very dense flora (e.g. a forest) - with little or non undergrowth.
- More shade tolerating flora present in valleys than on the plateau.

Moisture

- **Xerophytes** plants can withstand and survive in extremely dry conditions.
- **Mesophytes** plants prefer wet areas.
- **Bulbous** plants store moisture in their bulbs to survive during a drought.

The topography of the land can also influence the moisture in the following ways:

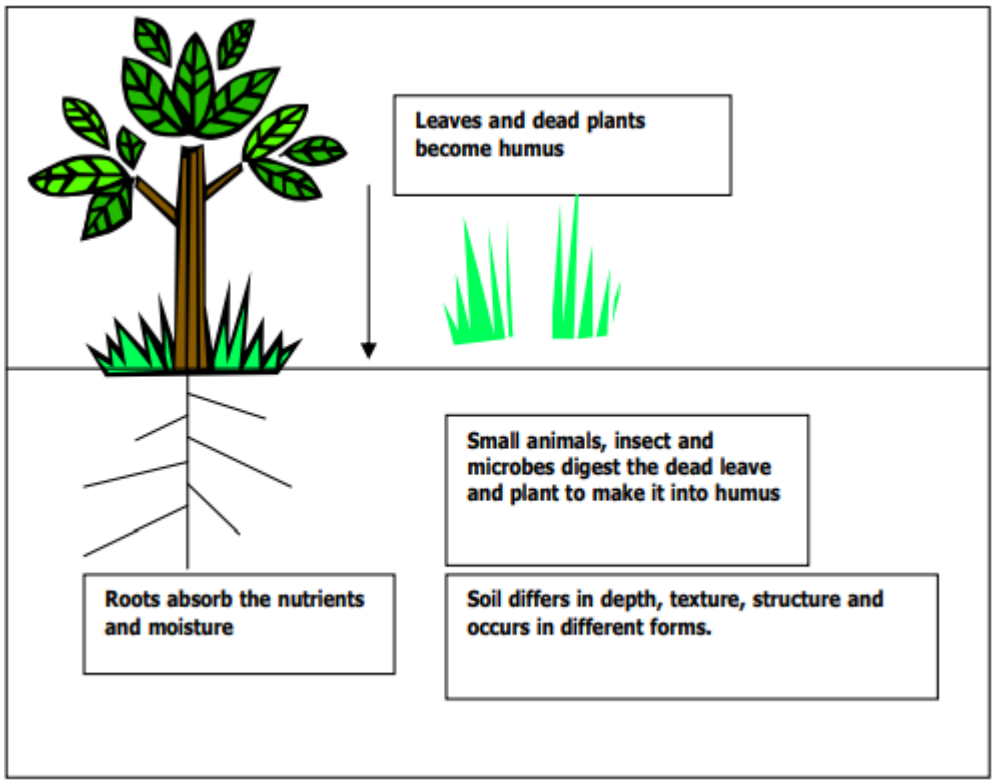
- The tempo of runoff water is higher on sloped areas – absorption of water low - than on the flat areas.
- The water absorption will depend on the type of rain, soil and the angle of the slope.



Soil

Soil is formed by erosion and weathering of rocks, thus a medium for natural vegetation to grow in. This newly formed soil is unfertile at first, but with the support of plants the formation and fertility is changed, allowing the survival of different kinds of flora. The plants take up nutrients from the soil but replace it again in the form of compost (leaves or dead plants parts). The excrement of the animals, after eating these plants, also adds nutrients to the soil for plants to grow on.

Different plants prefer different soil types. It is thus important that plants are planted in an area where they are adapted to.



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The humus and the mineral clay fraction play an important role in controlling many of the properties in the soil

- **Absorbing** large quantities of water
- **Adsorbing** mineral nutrients and reduce losses which may result from leaching.
- **Acting as a cementing agent**. Individual soil particles are cemented into aggregates by the small humus and clay particles.

	**Individual Activity 8**

Availability of natural resources

To determine the availability of natural resources the following can be done:

Water

Determine the volume of water a bore hole can deliver by using a test pump for at least 8 hours. That will determine the capacity of water supply. Determine the depth of the borehole as well as the distance to the reservoir to calculate the choice of pump as well as total costs of water supply. All the other water sources – dams in catchments, etc. need to be calculated to determine whether there will be sufficient water supply for e.g., irrigation or animal use.

The soil

The quality, type and nutrient content in the soil can only be determined by soil analyses. (The method of soil sampling is discussed in unit 116309).
The outcome of these analyses is very important as it will aid the farmer during the decision-making process to determine the use of the soil - crop production, production of fodder or animal grazing.

Natural vegetation

Determine the veld condition and occurrence and quality of natural vegetation - based on the extent of dominant species and the overall covering – whilst the veld is in an optimum growing condition. The idée is to select standard sites which will be used as benchmarks when rating the veld in the same ecological zone.

Selecting of a benchmark site:

Choose a site that is

- Productive and stable,
- Represents the type of veld that is suspected to be the natural veld,
- Representing the climax state of the veld.

The site is analysed in the following manner

- Select an area of 30 m x 30m - approximately 0.1 ha
- Record within this area - at 200 randomly allocated positions - the specie's occurrence and basal covering by means of a wheel point apparatus. (You can also make use of your shoe – e.g., mark your left shoe with chalk and every time your left shoe touches down, identify the species next to the mark.
- Record the strikes as follow

Strike	Living basal covering	Species of plant closest to the point
1		
2		
3		
4		
5		

% basal cover = number of strikes from the 200 points / 2 % contribution of each species = number of recorded positions for each species from 200 positions /2 The species in the benchmark site must then be classified in four classes

Veld condition score sheet				
	Class	**% of the species**	**Benchmark**	**Sample site**
	Composition score		**100**	
1	**Decreasing species**			
2	**Increasing I species**			
3	**Increasing II species**			
4	**Increasing III species**			
	Cover			
	Abundance of poisonous plants	**Scale of 1 – 5**		
	Vigour of Decreasing species	**Scale of 1 – 5**		
	Age distribution of grass plants	**Scale of 1 – 5**		
	Soil erosion	**Scale of 1 – 5**		

Where the veld survey indicates deterioration of the natural vegetation due to over grazing or other factors, the following need to be done to prevent further degradation:

- Reduce the stocking rate
- Provide appropriate resting period

In the savannah area it is also necessary to analyse the tree components of the vegetation and not only the grasses and other plants. The trees must be recorded separately

Condition indications of trees:

		Height	**Conclusion**
1	**Lower density of mature trees as on benchmark site**	**+ 2 m**	**Sample site was previously bush cleared**
2	**Higher density of seedlings**		**Indicates that bush is encroaching**
3	**High density of coppice plants**		**That the fire alone was inadequate in controlling bush encroachment**
4	**High density of seedlings and coppicing browse plants**		**Large food resource for browsers**
5	**High density of seedling and coppicing non-browser species**		**The un-utilisable components of the veld is increasing because grazing is excessive and fires to infrequently or insufficient in intensity**

Coppice plants: – a small clump of trees with undergrowth - new wood growing from the bottom of plants.

A management program can be compiled with this information (the tree population and grass analysis) regarding the camp rotation, type of animals (sheep, cattle or game) that can be used and the stocking rate.

LAND USE PLAN

A land use plan is a detailed compilation of what happened on a specific land or veld in the past (yield, input costs, fertilisers, etc.), thus the complete history of every land or camp. A farm management plan can barely be compiled without this recorded information.

This is and example of a land use plan for a natural pasture.

Land use plan for Grazing camps 2008								
	Camp 1		Camp 2		Camp 3	Camp 4		
Land size	15 ha		109.		60.9	59.1		
Soil								
Soil Type								
- Classification								
- Depth								
- Clay %								
Sub soil								
Soil Fertility								
Organic material content								
Nutritional status								
N								
P								
K								
ph level								
Production History	LSU	G/D	LSU	G/D	LSU	G/D	LSU	G/D
2004								
2005								
2006								
2007								
AVE yield								
Natural vegetation								
Dominant species								
Decreasing								
Increasing I								
Increasing II								
Increasing III								
Land use plan - 2008 2 of 2								
Grazing or veld	Camp 1		Camp 2		Camp 3	Camp 4		

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management				
Rest period				
Fire				
Cut for hay				
Fertiliser application				
Other information				

STRATEGIC PLAN FOR THE USE OF NATURAL RESOURCES

Natural resource management:

Natural resource management (NRM plan) is a holistic plan drawn up to manage all the natural resources on the farm in a sustainable way to ensure optimal production and improvement or maintenance of the natural resources.

The following specific objectives were developed for NRM plans to guide management strategies:

- ❖ To promote sustainable resource use, particularly in sustainable agriculture.
- ❖ To protect and improve the condition of land, water (including groundwater) and vegetation resources which support sustainable resources.
- ❖ To improve water quality and environmental condition regarding surface and ground water systems, as well as wetlands and estuaries and to promote the correct use of water.
    - o to reverse the decline in the extent and quality of natural vegetation and to maintain and restore the habitat for flora and fauna.
- Data needed to determine the present condition of natural resources:

- **Climatic data** – the rainfall, temperature, first day of frost, heat units.
- **Soil data** – soil type, soil formation, topography, soil fertility.
- **Veld condition** - vegetation /basal covering.

Analysis of the data

The collected data can be used to make recommendations or decisions but need to be analysed as first to:

- determine the condition of the natural resources,
- the availability of the resources and
- the use there off

The collected data, concerning the natural resources, is now used to draft the short and long term strategies which must provide for;

The production of different products,
The management of the natural resources,
The effect of production on the natural resources and
The management and protection of natural resources.
The strategic planning must also include and make provision for the following external influences:

- the local economy
- the availability and costs of inputs
- the world economy
- the demand for products
- technological advances
- the preference of the consumers

All these factors play a role in the decision making as it may change the direction of the production and the production process. The manager must acknowledge these factors to be able to formulate the changing of plans in time.

Recommendations

The collection of data is the foundation for planning. Planning is not a once-off act but changes according to circumstances. These changes must be within the parameters of the strategic plan and be required only because off changes in the internal or external environment.

All the role players must take part in the planning of a natural resource management plan to ensure that all the aspects are taken into account.

Monitor changes of biodiversity over time

Natural resources must be monitored on a predetermined schedule. These evaluations must be compared to the previous evaluations or benchmark. The slightest change — will be observed immediately, enabling management to take action if necessary.

These evaluations will also assist to update production records and to get a general view on the future production possibilities.

A benchmark is a predetermined factor (barometer) - the ideal you strive for - and used to measure the management plan of the natural resources progress - positive or negative. If there was no progress, the situation need to be addressed and the reasons for not achieving the goals must be identified enabling management to work out new strategies to overcome these problems or short comings.

SCHEDULED ACTIVITIES TO MAINTAIN NATURAL RESOURCES

One-year plan of activities

Year plan for maintenance of Natural resources - Summer rainfall area		
	January - Summer Camp rotation. Make hay of excess roughage. Store the hay away. Maintain roads and runoff water structures.	February Summer Make hay of the excess roughage. Store the hay away. Maintain roads and runoff water structures.
March - Autumn Make fire breaks. Maintain roads and runoff water structures.	April - Autumn Make fire breaks. Service fire equipment and keep ready for use. Start with the eradication of alien plants and weeds in vlei areas and water ways.	May - Winter Use rested camps. Provide ruminants with winter lick. Put fire control action plan in action for the next four months. Start with the maintenance and repair of contours and areas that were damaged by erosion.
June - Winter Use rested camps. Use crop rests (if available). Provide ruminates with winter lick. Control alien plants in grazing and wetland areas.	July Winter Use rested camps. Use crop rests (if available). Start feeding supplementary roughage – e.g. hay. Provide ruminants with winter lick.	August - Winter Use rested camps. Use crop rests (if available). Start feeding supplementary roughage – e.g. hay Provide ruminants with winter lick. Burning of veld as veld management tool.
September - Spring Maintain roads and runoff water structures. Burning of sour veld as part of veld management strategy. Makes sure water provision to camps are in order.	October Spring Start with camp rotation program. Correct the number of grazing animals. Ensure fences are fixed. Burn camps if it is part of bush control program. Plant annual fodder crops.	November - Summer Plant annual fodder crops. Camp rotation. Cut grass /roughage for hay to ensure good quality. Control alien plants in grazing and wetland areas.
December - Summer Camp rotation. Control alien plants in grazing and wet land areas.		

Activities to coincide with other farm activities Although the different farming enterprises complement each other, different actions are required at different times as some activities will be peak in summer while other activities may peak during winter - depending on the enterprise.

Some farms may again have continuous production enterprises such as a dairy, egg supply, feedlots, etc.

Then off course there is Sop's - specific operational procedures or practices - things that must happen at a specific time e.g., calves must get colostrums within the first 12 hours.

Delegation of tasks

Delegate:

To assign a component of your power or a section of your work to subordinates (someone in a lower position) to assist you with the work that need to be done, but the responsibility will still remain with you. When you delegate work it is your responsibility to ensure that the work is done.

Components of delegation: - trust, guidance and supervision.

When should you delegate a task?

- When you have more work that you can handle effectively.
- When you cannot allocate sufficient time to priority tasks.
- When you want to train and upgrade subordinates
- When a subordinate can adequately perform the work

How do you delegate tasks to subordinates?

You need to decide on the following:

- What must be delegated?
- To whom must I delegate the work?
- How to inform (brief) the subordinate
- How to guide to subordinates
- The monitoring process

What can be delegated?

- A task that you do not normally do yourself.
- Recurring or routine tasks can easily be delegated.
- Specialist task that you cannot do yourself or when you do not have the skills to do the task.
- A task that comforts a subordinate.

Tasks are delegated to staff who have the skills, knowledge, time and motivation for it. The outcome of delegating a task to a person that do not have the knowledge or skills may be fatal (economically spoken), so rather use an individual with intelligence, natural ability and the willingness to assist you.

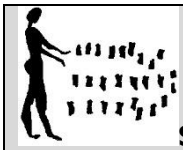
When a task is delegated, ensure that the subordinates understand:

- The necessity of the task
- What is expected from them
- Dates for report back and completion - deadlines
- The authority that is given for decision making
- How to deal with problem they encounter
- How they will be guided and monitored
- The resources and facilities to be used for the completion of the work.

Monitoring of the performance or progress

Set target dates for sections of the task and the eventual deadline for the task as a whole – no tolerance – but act humanly as something unforeseen may happen.
Important - feed-back must also be given at the agreed time or date.
Subordinates must know the reach of authority given to them.
A Delegation can only succeed if there is an understanding and acceptance of the strengths and weaknesses of the staff and the situation they work in.
The responsibility remains with the person who delegates, but the decision making lies with the person to whom a task was delegated.

Individual Activity 9



SUMMATIVE 4A

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Water Quality

Unit Standard	
116322	Manage water quality parameters
Specific Outcomes	
SO 1: Correctly assess, analyse and evaluate water quality data and independently decide on the corrective actions within operational technical systems to well defined, but possibly unfamiliar problems. SO 2: Demonstrate a thorough understanding of the reasons, impacts and implications of specific corrective actions related to water quality. SO 3: Implement corrective actions related to the quality of water and water quality systems. SO 4: Evaluate the effects of corrective actions or adjustments on the water quality requirements.	
CCFO's	
Identifying	Working Organise

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WATER QUALITY DATA

Introduction

When mentioning data, one would normally think of a laboratory report. When it comes to the assessment, analyses and evaluation process however, observations and records from the farm are equally important.

Although methods vary in the degree of sophistication, the results are of equal importance in the process. A simple observation, such as feeling the grittiness of the deposits in the pipe lines, is of no less importance than determining the concentration of sodium using an ICP costing R1 million.

The majority of the data required in a management system to assess, analyse and evaluate water quality management is generated on the farm. Analyses by outside facilities are limited to the analyses of the water itself and sometimes deposits found in the system. These analyses are mostly used to confirm on-farm analyses and observations.

Usually the water quality manager (WQM) has little say in the quality of the water received on the farm. The quality is good, marginal or poor. The task of the WQM is to improve those water quality factors that can be improved and manage the others to minimise their impact on profitability and the environment.

In general, water quality factors impact on the irrigation system, soil productivity and crop production. The challenge is to decide when to take action to eliminate the factors and when to manage the impact. The framework for all these decisions is the profitability of production in a sustainable environment.

Effects of physical water quality factors

The main effect of the physical water quality factors (PWQF) is blocking or clogging of the emitters. The standard set by the Department of Water Affairs and Forestry (DWAF, 1996) for the clogging hazard of water is as follows:

Rating	*Suspended Solids per Litre Water (mg)*
Minor hazard	less than 50mg
Moderate hazard	50mg to 100mg
Severe hazard	more than 100mg

Apart from the PWQF the chemical (CWQF) and microbiological (MWQF) factors also contribute to clogging of emitters. These can be tabulated according to DWAF as follows.

	Unit	*Low Hazard*	*High Hazard*
Physical Water Quality Factors			
Suspend solids	mg per litre	<50	>100
Chemical Water Quality Factors			
pH		<6	>8
Bicarbonates	me per litre	<1.64	>3.28
	mg per litre	<100	>200
Calcium	me per litre	<0.50	>2.50
	mg per litre	<10	>50
Manganese	mg per litre	<0.10	>1.50
Iron	mg per litre	<0.20	>1.50
Sulphide	mg per litre	<0.20	>2.00
Total dissolved solids (TDS)	mg per litre	<500	>2,000
EC	mS per m	<75	>300

Microbiological Water Quality Factors			
Total bacteria	Number per millilitre	<10,000	>50,000

Note: The following conversion factors apply to the units of the table above:

me per litre = mg per litre / equivalent weight Equivalent weight = atomic weight/ charge of the ion.

The effects of clogged emitters are so devastating on production that water classified as having a Low Clogging Hazard still needs treatment, because some of these factors have a cumulative effect on the irrigation system. Therefore, apart from the initial analysis of the water, continuous monitoring these factors in the piping and emitters is essential.

The above classification needs adjustment based on the hazard that can be caused by the accumulation in the pipes. The assessment is done as in the example below:

Assessing Water Quality Control Systems

PWQF: Suspended Solids	Assessment	Actions	Comments
< 50mg per litre	Minor clogging hazard but can accumulate. Requires action.	Filtration	Suspended solids will accumulate in the piping and will eventually cause emitters to clog[1].
Suspended solids 50-100mg per litre	As above	Filtration	As above[1].
> 100mg per litre	Needs action	Sedimentation, cyclones, filtration,	These techniques and level of physics and engineering fall outside the scope of this material. Seeks specialised advice.

The rate of accumulation of suspended solids as well as the agglomerating effect of the bacteria will depend on a number of factors, including temperature, flow rate in the pipes, temperature, etc. The requirement should be included in the specifications for the filtration system. This forms part of an irrigation system design and a filtration system should be installed with the capacity to handle the load of solids for the specific water.

Effects of chemical factors

Assessing, analysing and evaluating date relating to the chemical water quality factors and determining the best course for corrective action are much more complicated than is the case with data relating to physical water quality factors.

Certain chemical factors cannot be corrected economically, and the water quality manager can only take steps to limit the impact on production and the environment. The type of irrigation system used, i.e., micro-jets or drippers, also have an influence on the actions that can be taken to correct and/or minimise the impact.

Corrective actions include those to improve the CWQF and those to reduce the impact on the environment and on crop production.

Chemical Water Quality Factor	Measurement	Assessment	Actions	Comments
pH	<6.00	Is suitable for most pesticide and nutrient sprays and need no treatment. Some pesticides and nutrient sprays need a higher pH.	None Buffer the pH at the desired level.	Half-life of pesticides depends on the pH of the spray solution. Buffer solutions for various pH levels are available. Consult supplier.
		The corrosion potential of the water is high. Treatments are required.	This is a specialised action. Seeks expert advice.	A low pH in combination with a low salt will increase the corrosion potential. The Corrosively Index (CI) is used to evaluate this.
		No need to use acids in drip irrigation systems.		Nutrient solutions can be formulated without addition of acids, provided the added chemicals will not increase the pH.
	6.00-7.00	Solutions of some pesticides and nutrient sprays need to be acidified.	Identify the pesticides and nutrients and select the appropriate acid.	The main contributor to high pH is bicarbonates. However, there is no correlation between pH and the bicarbonate concentration.

		Acidification of irrigation water used in a drip system is an option. Reduce the pH while adding nutrients and utilise the nutrients already in the water.	Select the most suitable acid or buffer solution.	Water with this pH level usually contains Ca, Mg and S which should be incorporated in the formulation of the nutrient solutions.
	7.00-8.00	Solutions of most pesticides and nutrient sprays need to be acidified.	Select the most suitable acid or buffer solution.	
		In combination with high Ca levels, scale forming and clogging are possible.	Acidify continuously for drippers and *ad hoc* for micro-jets.	Langelier Index is an indicator of the potential for scale formation.
		Acidification of water used in micro-jet systems can possibly be justified during July to November.		Acidification can also be undertaken on an *ad hoc* basis to clean the system. Water applied through micro-jets is seldom acidified, mostly due to the cost of the acids and the lack of proof of benefits.
		Acidification of irrigation water used in drip systems is a must to reduce pH, add nutrients and utilise the nutrients already in the water.		Using nitric and/or phosphoric acid will reduce the pH and add nitrogen and/or phosphorus without much change in EC.
	> 8.00	In conjunction with high Ca concentrations clogging and scale forming are real threats.	Acidify.	The volume of acids required to reduce the pH might be so much that N and P is over-supplied. Other acids are required. Consult a specialist advisor.
EC	<75	Low salt content. Requires no special attention.	Monitor the metal and cement components for signs of corrosion.	A leaching requirement (LR) of up to 10% is necessary.

	75-125	Suitable for most soils and crops.	Apply the leaching (LR) requirement for the particular water during each irrigation cycle.	When the LR of between 10% and 15% is added to the volume of water applied, the salts will not accumulate in the root-zone.
	126-200	Not suitable for irrigation of crops with conventional systems.	Consult a specialist.	When the EC of the water is greater than 150mSm^{-1} plants need energy to utilise the water and production will suffer.
	>200	Not suitable for irrigation unless specialised equipment and techniques are implemented.	Consult a specialist.	
SAR	<1.00	No sodium hazard.	None	
	1.00-3.00	Crusting is possible.	Monitor the infiltration of water into the soil. If runoff occurs, consider the application of gypsum.	Crusting will slow down the infiltration rate and free water will accumulate on the surface. This is the first sign of the detrimental effect of too high sodium content.
	>3.00	The sodium hazard needs attention.	Consult a specialist.	
Ca	>50mg/litre	In combination with a high pH, high carbonate or bicarbonate concentration will cause clogging.		
Mg	>50mg/litre	Continuous use of the water will induce a potassium deficiency in plants.	Monitor the potassium level in the soil and leaves and act accordingly.	Magnesium and potassium act mutually antagonistic, i.e. they oppose each other's uptake and functioning.
Cl>	50mg/litre	High chloride concentrations promote salinity in	Monitor the chloride levels in the leaves and soil and avoid	The leaves will accumulate the absorbed chlorine

		the root-zone and can cause scorching of leaves when used for spraying.	wetting leaves with the water during irrigation.	until toxic levels are reached. The edges of the leaves can be scourged and leaf drop will occur.
B	>1.0mg/litre	Boron toxicity may develop.	Monitor the boron concentration in the leaf. Consult a specialist.	Symptoms of an excess of boron includes yellowing of the tips, development of chlorotic blotches and premature leaf drop.
Nitrogen	>20mg/litre	Using this water during January to June may result in poor fruit quality.	Monitor the N concentration in the leaves as well as the colour development of the fruit.	For proper development of the orange colour of the fruit, little or no nitrogen must be applied during January to June.

Buffer Solution

Buffer solutions have the ability to absorb or release protons (hydrogen or acid ions) in a solution in order to keep the pH constant. Buffers have a limited pH range and different buffers must be used to buffer the pH at various levels.

Chlorosis and Negrosis

Chlorosis is the yellowing of local areas on a leaf. This is usually the first sign of a detrimental incidence in or on the leaf. The cells are not dead and sometimes the reaction can be reversed. Negrosis is the step following chlorosis when the cell die and brown areas or spots appears on and in the leaf. Negrosis is irreversible.

Apart from the salts in the water that can cause clogging, salts added as fertilisers can also aggravate the clogging hazard.

Effects of microbiological and biological factors

In fruit production, the microbiological and biological water quality factors (BWQF) are limited to those that promote the growth of bacteria and slimes in the piping after filtration. The bacterial and slime growth act as agglomerating agents to bind other suspended material into lumps that will block the emitters. The growth is aggravated by addition of nitrogen, phosphorus and organic carbon (molasses, organic acids or buffers). Applying nutrient solutions through the irrigation system will stimulate the growth of the microbes.

Treatment is applied before, during or after filtration. The best results are however obtained when the complete system (filters, supply lines, laterals and emitters) is disinfected. Drip irrigation systems need continuous disinfection. This decision should be based on historical data and current analyses, including those of the deposits in the piping and emitters.

Although DWAF indicates that less than 10,000 organisms per ml poses a low clogging hazard, the bacteria multiply in the pipes and any number will eventually clog the emitters. The bacteria population in the system must be monitored continuously and action taken accordingly. The most effective method to determine the presence of the different microbes is to evaluate the deposits in the pipes when flushing the system.

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Principles and use of operational technical systems

The technical systems involved in water quality management are so closely related to the irrigation and fertigation systems that they are usually also managed by the irrigation manager. These include the filtration, acid and disinfectant applicators. Only under extreme conditions will such technical systems be managed by the water quality manager.

Dosing apparatus

Acidification and disinfection are done by using the same equipment as for applying fertilisers. The selection and operation of these systems form part of the irrigation program. The equipment consists mainly of dosing apparatus which will introduce the acid or chlorine into the irrigation water. Two groups of dosing equipment are available (Koegelenberg & Conradie, 2000).

- Passive dosing apparatus This group includes apparatus that sucks the acid or chlorine solution into the stream of water in the pipes. This can be done at the suction end of the irrigation pump, a venture system, or a pressure tank connected to the irrigation system.
    - Using the irrigation pump for dosing The reservoir with acid or chlorine is connected to the intake end and the chemicals are sucked into the system in the same way as the water. The volume can be regulated by a tap. This is a simple and cheap method, but the acid and chemicals may damage the pump.
    - Using a venturi for dosing
      The venturi is fitted in the pipeline. When water flows through the venture, a localised drop in pressure is caused. The container with the chemicals is connected to the area of decreased pressure and the chemicals are forced into the pipeline by atmospheric pressure and carried by the water. The rate of intake can be regulated.
    - Using a pressurised tank for dosing
      A tank is connected at two points to the irrigation pipe. Between the two connecting points, a valve or tap is fitted to create higher pressure at the first point. The water flows through the tank and, due to the lower pressure at the second point, re-enters the pipeline on its way to the trees.

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- Active dosing apparatus

  This group represents all the types of pumps that are used to force the solutions of the chemicals into the pipe line. These include pumps utilising centrifugal forces, screws, diaphragms, pistons, peristalsis and gears to force the chemical solutions into the irrigation system.

  - Filtration equipment
    The filtration system forms an integral part of the irrigation system, but the type and capacity depend on the quality of the irrigation water. Three types of filtration systems are available.

  - Mesh or screen filters
    Mesh filters are made of stainless steel or nylon compounds. The size of the openings and the total mesh area determine the capacity of the filter. Mesh filters are used to filter water of good quality but that contains sand and silt. It is not suitable to remove algae form water.

    The mesh number refers to the number of cross wires per square inch that create the openings.

Standard Filtration Grades

Size of Openings (microns)	300	250	200	130	100	80
Size of Openings (mm)	0.30	0.25	0.20	0.13	0.10	0.08
Mesh Number	50	60	75	120	155	200

Ring or disc filters

Ring filters have a three-dimensional filtering action and a higher capacity than mesh filters for the same measurements. The filter unit consists of a number of flat plastic discs with grooves on the flat side. When packed together in a cylinder, they form a surface with small channels form the outside to the inside of the cylinder. Water is filtered when it flows from the outside to the inside of a cylinder through this maze of tiny grooves. Ring filters are cleaned by backwashing, when water flows from the inside to the outside of the cylinder.

Sand Filters

Sand filters remove organic and inorganic material, but not suspended clay particles, from the water. It is also a three-dimensional system with a high capacity. The particle sizes of the sand used are specified to remove suspended solids with a diameter of as small as 80 microns (0.08 mm). The lower the flow rate through the sand filter, the better the filtration. Sand filters are always used in conjunction with a disc or mesh filter.

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UNDERSTAND THE IMPACT OF CORRECTIVE ACTIONS

Scholastic and technical concepts related to water

The reason for any water treatment should be to:

- Improve the quality,
- Minimise the negative effect of the water quality factor on the soil, tree, and environment; and/or
- Improve economic returns.

For every water treatment, or corrective action, there is a side-effect, or implications, which is not always desirable. Before taking corrective actions, consider the consequences, which in many cases develop over time. Apart from the direct effects and the side-effects of a treatment, the cost-efficiency must also be considered that needs to be considered, for instance desalting irrigation water will have a positive effect on production, the soil and environment but is simply too expensive.

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Treatment	Desired Effect	Impact	Side Effect
Sedimentation	Sedimentation removes some insoluble material at low cost.	Sedimentation dams nd extra pumping facilities are required.	Sedimentation dams silt-up and require removal of the silt. The frequency depends on the concentration of the insoluble material and size of the dam.
Filtration	Filtration reduces emitter blockages.	A major must for micro-irrigation.	None, but without filtration the clogged or partly clogged emitters will supply too little water to the trees and production will be reduced.
Decreasing pH	Lowering the pH make pesticides more effective.	Improve effectiveness of treatment, hence fewer treatments or lower concentrations and better production.	Acidifiers/buffers must be compatible with pesticide. Some pesticides MUST NOT be acidified and can cause damage to fruit and leaves when acidified.
	Lowering the pH to improve solubility and utilisation of nutrients.	Acids add another ion to the water while it removes the bicarbonates. Nitric acid adds nitrate; phosphoric acid adds phosphate and sulphuric acid adds sulphates.	Citrus requires the majority of the nitrogen during July to October and little during February to June. The presence of nitric acid may cause problems. With micro-jets, phosphoric acid is not an effective source of P. Waters with a high pH usually contains high concentrations of sulphates.
Lowering EC	Lowering the EC will improve production, etc.	Currently too expensive for irrigation and foliar sprays. Electro-magnetic treatment will decrease surface tension of water and could assist in leaching salts from the root-zone.	Need to meet the leaching requirement for this combination of soil, water and crop. Extra water will be required.
Disinfection	Disinfection will reduce blockages.	A major must for micro especially drip irrigation.	

Data analysis

The process of assessing, analysing an evaluating data starts with a comparison of the laboratory results with the standard set of norms (DWAF). Thereafter, a series of questions and answers will add value until satisfactory decisions can be made.

Data analysis

The laboratory report indicates that the water contains 55mg per litre suspended solids, which is, according to the above rating, a minor clogging hazard. This data must be assessed, analysed

and evaluated to make a sound business decision. Is it necessary to filter water to remove the 55mg per litre suspended solids? If the concentration of suspended solids were 155mg per litre, it would have been clear that the water required to be filtered. To assess, analyse and evaluate the data additional information is required, for instance: • Was the sample taken correctly? • Are the 55mg suspended solids clay and/or silt particles, plastic cuttings, seeds or organic debris? If this can be established, it may be possible to address the specific source. • How many emitters were blocked in the past three months / six months / year? All the extra information is generated on the farm and, if properly recorded, add value to the current results and support a proper decision. Every time you answer one of these questions, you make the final decision easier and more valuable.

Evaluating the PWQF before filtration

	Information	***Decision***	***Questions***
1	68mg suspended solids per litre water.	Minor clogging hazard.	What type of solids?
2	Solids consist of silt, clay and plastic cuttings.	Train staff to use sharp knives when repairing plastic tubing.	How many emitters clogged the past three months?
3	3% of emitters were clogged in the past three months.		Can this be detected before it impacts on production?
4	Easily, with current monitoring system.	Prevent plastic in the system and continue with current filtration system.	

Evaluating the PWQF after filtration

	Information	**Decision / Conclusion**	**Questions**
1	78mg suspended solids per litre water.	Minor clogging hazard.	What type of solids?
2	Solids consist of silt, clay and slimy material.	Ineffective filtration and build-up of microbes.	What protocols are followed to clean the system?
3	Chlorination, but not done in last four months. Flushing laterals once per month according to	Investigate breach of protocol.	Maintenance records for filtration system are required.

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	protocol.		
4	Not available.		How many emitters clogged?
5	16% the past three months.	Investigate breach of protocol.	How can developments like these be prevented and/or detected in time? What material clogged the emitters?
6	Whitish precipitate that dissolves in acid and slimy substances.	Possibly calcium carbonate and bacterial slimes.	When was the water analysed and what was the pH, calcium, bicarbonate concentration and bacterial counts?
7	March 2005 pH=7.5 Ca=30mg Bicarbonate=125mg Bacteria=1500 per litre	Compared to pervious analysis, not much change in the composition.	

The procedure for assessing, analysing and evaluating data and taking decisions on corrective actions are based on actual measurements, but value is added to the analytical data by using historic records. The process does not stand alone but forms part of a management system. Any breach in recordkeeping decreases the value of any current data.

The following table serves as a guide to identify the causes of clogging together with some recommendations to correct the problem. (Hansen et al. 1992)

Cause	**Solution**
Whitish precipitate indicates carbonates. The pH is usually >7, 5 and HCO_3 content >120mg per litre.	Continuous application of acid to maintain a pH in the water of between 5.0 and 7.0. Or Shock treatment with acid at a pH of 4 for 30 to 60 minutes.
Reddish precipitate indicates iron deposits. The water contains >0,1mg Fe per litre.	Aerate the water – suitable for water containing > 10mg Fe per litre. Chlorination at a rate of 1mg chlorine per 0.7mg Fe per litre. Apply the chlorine before the filter in order to remove the precipitated iron. Reduce the pH to 4.00 for 30 to 60 minutes every day to dissolve the Fe precipitated during the day to prevent accumulation.
Dark / black precipitate indicates manganese deposits. The water contains >0, 1 mg Mn per litre.	Apply chlorine at a rate of one mg per 1.3mg Mn per litre water before the filter to remove the precipitated Mn.
Reddish slime indicates bacteria using iron in their metabolism.	Chlorinate at a rate of 1mg chlorine per 0.7mg Fe per litre continuously or 10 to 20mg chlorine for 30 to 60 minutes. Apply

The Fe content >0, 1 mg per litre.	the chlorine before the filter in order to remove the precipitated iron.
Whitish fluffy slime indicates sulphur bacteria. The water contains >0,1mg S.	Chlorinate at a rate of 1mg chlorine per 4 to 8mg S per litre continuously or 10 to 20mg chlorine for 30 to 60 minutes.
Algae and other slimes.	Chlorinate at a rate of 0.5 to 1.0mg chlorine continuously or 10 to 20mg chlorine for 20 minutes at the end of the irrigation cycle.
Black gritty precipitate indicates iron sulphide at a concentration of > 0.10mg per litre water.	Continuous application of acid to maintain a pH in the water of 5.0 to 7.0.

Aeration

Aeration means the addition of air or oxygen to water. The simplest method is to spray water into a dam through the air, where it will dissolve oxygen. Another method is to bubble air through water.

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CORRECTIVE ACTIONS

Water quality and processing systems

Most micro irrigation systems include one or more processing systems to improve the quality of irrigation water. For the irrigation of citrus by means of micro-jets and drippers filtration, acidification and disinfection are standard procedures. The frequency of acidification and disinfection depends on the quality of the irrigation water.

Filtration

Designing an irrigation system usually includes the filtration system. The type and number of filters depend on the quality of the irrigation water and the type of irrigation system. Little or no filtration is required for flood irrigation, while a dripper system will almost always use some sort of filtration.

The filtrations system may include one or more of the following:

- Sedimentation dams

- Cyclones
- Sand filters
- Mesh filters
- Disc filters

The operation and maintenance procedures are prescribed by the supplier or manufacturer of the system, and will not be discussed in this section. However, these procedures should form part of the system's management protocols.

Acidification

Acidification is done by using techniques that vary in their degree of sophistication. The techniques include pre-dilution of the acid before adding it to the irrigation water; adding the concentrated acid to the water during irrigation by means of pumps or a suction action. Pumps and suction units used for this purpose are controlled manually or by computer.

Whatever technique is used, the operation and maintenance instructions will be supplied by the supplier or manufacturer. These procedures should form part of the system's management protocols.

Acidification is also done to dissolve carbonates of calcium and magnesium which pose a clogging hazard by continuous application of acids, such as in hydroponics, or by using a so-called shock treatment. The shock treatment allows the acid at a concentration of 0.6% (Leading drip irrigation supplier, 1998) to remain in the system for one hour, after which it is flushed out with irrigation water. The 0.6% concentration is applicable only when the concentration of the various acids is:

- Hydrochloric acid 33-35%;
- Sulphuric acid 70%;
- Nitric acid 60%; and
- Phosphoric acid 85%

If the concentration of the available acids differs from these values, adapt the % with a factor of 0.6 x % stated / % available.

Adapting the Acid Concentration

Nitric acid is available at a concentration of 70%.
0.6 x % stated / % available
= 0.6x60/70
= 0.51%

Nitric acid is the most preferred chemical for this purpose, because all nitrates are soluble in water and nitrate is also an essential nutrient.
The following procedures are recommended (Leading drip irrigation supplier, 2000):

- Calculate the volume water in the system at operating pressure;
- Calculate the volume acid required to add 0.6% acid to the volume of water in the system;
- Connect the injector pump to the irrigation system to be cleaned after the filter;
- Start the irrigation system and let it gain operating pressure;
- Inject the acid into the system over a period of at least 10 minutes;
- Stop the irrigation to the specific block for one hour;
- Resume irrigation for at least another hour to flush-out the acid and regain the pH in the soil/root zone before the acidification process.

Disinfection

Disinfection of the water and system is done by applying sodium or calcium hypochlorite, hydrogen peroxide, ozone or other disinfectants. Hypochlorite and hydrogen peroxide are the most commonly applied agents. The principle of disinfection is that the chemicals kill the microbes, oxidize some of the simple organic molecules and even manganese and iron. These chemicals can be used in a maintenance or corrective program.

❖ Maintenance Application

In the maintenance program, these chemicals are applied at frequencies determined by historical data and current assessments and/or analyses. The microbial counts in the irrigation water initiate the inclusion in the maintenance program. Data on clogged

drippers or micro-jets and analyses of the deposits in the pipes determine the frequency.

- ❖ Corrective Application

  Corrective or shock treatments are done to bring the microbial population down to acceptable levels in a short period. This is done by applying the chemical at a high concentration at the end of the irrigation cycle.

Chlorination

Chlorine is a strong oxidising agent. It oxidises organic deposits and slimes to carbon dioxide. In this process, the living organisms are killed. Iron and manganese will also be oxidised to prevent precipitation. Microbes, iron and manganese must be in contact with the chlorine for a minimum period and at a minimum concentration in order for the oxidation to be completed.

Information – Chlorination

Chloride is formed when chlorine has oxidised organic material or manganese. In the process the chlorine atom is reduced to the inactive chloride form. Chloride will not oxidise organic material and at a moderate concentration kill microbes.

Recommended Concentrations for Active Chlorine for Various Management Systems

Purpose of Chlorination	*Method of Chlorination*	*Recommended Concentration (mg/litre)*	
		Injection	*End Emitter*
Prevention of organic growth on the inside of pipes.	Continuous	3 to 5	>1
	Periodically*	10	>3
Cleansing the system.	Continuous	5-10	>3
	Periodically*	15	>5

- Inject the chlorine during the last 30 to 60 minutes of the irrigation cycle and leave it in the system over night.

The following procedures are recommended:

- Apply the chlorine as closely as possible to the system to be cleaned;
- The pH of the water should be between 6.5 and 7.2;
- When chlorination is done to precipitate iron and manganese, apply the chlorine before the filters;
- Before chlorination, flush the laterals properly;
- Free chlorine must be present at a concentration between 1mg and 5mg per litre at the emitter furthest from the injection, otherwise chlorination is incomplete;

- Chlorine concentrations exceeding 100mg per litre may damage certain parts of the system;
- Never mix chlorine and acid; x Use protective clothing and safety gear when handling acids and chlorine.

WATER QUALITY MANAGEMENT SYSTEMS.

A water quality management system needs to be developed according to the requirements of the irrigation system; the quality of the incoming water and the quality of water required at the trees. The requirements for a flood irrigation system will be much less stringent than with a drip irrigation system where water with almost no suspended solids and a pH of 6.50 is required.

To develop a management system, one has to identify the quality required, the improvements that can be made, sub-optimal quality factors that must be managed and what to measure to be in a position to manage the improvements and impact on the soil and trees.

The most common water quality processes that need to be managed with micro irrigation are the filtration, acidification and disinfection.

Filtration

The filtration process forms part of the irrigation system and is managed by the irrigation manager. However, specific points to measure the concentration of suspended solids must be identified, monitored, recorded and assessed continuously. These critical control points (CCP) must include:

- Incoming water;
- Water after filtration;
- Debris when flushing the pipes;
- Water when backwashing the filters; and
- Clogged emitters

Measurements and recordkeeping of this data enable the manager to take corrective steps before an incident occurs that causes damage.

CCP	Frequency	Measurement
Incoming water.	Twice per annum.	Insoluble suspended material in mg per litre.
After filtration.	Twice per annum or whenever repairs or maintenance have been done on the filtration system.	Insoluble suspended material in mg per litre.
Debris in pipes.	Monthly.	Insoluble suspended material. Identify the type and possibly the origin and estimate the volume / mass. Distinguish between silt (poor filtration), slimes (inadequate disinfection) and sand (valves that do not operate properly).
Backwashing water.	Base this decision on historic data of the incoming water and debris in pipes.	Insoluble suspended material in mg per litre.
Clogged emitters.	One or at least 10% of the clogged emitters should be opened and the deposit analysed in order to identify the case and origin.	Insoluble suspended material in mg per litre. Identify the composition with acid (carbonates will fizz, other salts will dissolve), by colour (red = iron, black = organic) and by touch (plastic, silt and clay and/or slimes).

The frequency in the table above reflects the minimum. Recorded data, the quality of the incoming water and seasonal variation will determine the actual frequency. Remember, rather a too high than a too low frequency.

Acidification

Acidification is not always required when micro-irrigation is practised. It is usually required in open Hydroponic systems or other drip systems during July to September / October for citrus. Its use is determined by economic decisions and the added nitrogen, phosphorus or sulphur should form part of the total fertilisation program.

Managing the pH of the irrigation water can be done manually or continuously aided by a pH-sensor and a computer. The acidification process of irrigation water can also be managed by recording the volume of water treated and the volume of acid used in the process. These volumes should add up to the estimated acid usage. The volume of acid is best be determined by a chemical titration. Otherwise the volume can be calculated based on the concentration of carbonates and bicarbonates.

The volumes of nitric acid and phosphoric acid required to acidify irrigation water to pH 6.0-6.5 are based on the concentration of the bicarbonates.

Bicarbonate me (mg) per litre water	Acid Required ml per 1000 litres water	
	Nitric Acid[1]	Phosphoric Acid[2]
0.10 (6.1)	7	2.86
0.20 (12.2)	15	5.71
0.30 (18.3)	22	8.57
0.40 (24.4)	30	11.43
0.50 (30.5)	37	14.29

1. 60% with a normality of 13.7 and density of 1.36
2. 285% with a normality of 36.4 and density of 1.69

When the volume of acid required is determined by titration, the volume to be added to the water can be calculated. Monitoring the acidification process can then be done as follows:

Orchard 11	Date	Acid Required ml/1000 litres
	19/05/2004	126
	11/06/2005	135

Date	Water Applied x 1000 litres	Acid Added Litres	Acid added ml/1000 litres	Difference %
15/07/2005	112,506	15,750	140	+3,7
16/08/2005	150,103	19 ,513	130	-3,7
15/09/2005	172,252	22,900	133	-1,5
18/10/2005	199,000	28,100	141	+4,4

Date	Water Applied x1000	Acid Applied Litres	Acid Added ml/1000 litres	Difference %	pH
15/07/2005	112,506	15,750	140	+3.7	6.34
16/08/2005	150,103	19,513	130	-3.7	6.12
15/09/2005	172,252	22,900	133	-1.5	6.31
18/10/2005	199,000	28,100	141	+4.4	6.45

Choose the recordkeeping system that suits the requirements best, but ensure that it supplies the correct and sufficient information for management to optimise conditions and prevent any hazardous incident.
Instead of acids available commercially, buffer solutions can be applied. The advantages of buffer solutions are that it is safer to use and over dosing is less of a problem.

Disinfection
Disinfection can be done continuously or periodically. Measuring the concentration of the free chlorine at the most distant emitter, is the best method to ensure that the treatment was done on all emitters at an effective concentration. Additional information, such as mass hypochlorite applied and intervals of application can assist in managing the process.

Maintaining quality in water quality management systems

The quality of any management system depends on the:

- Relevance of the measurements taken
- Accuracy of measurements
- Frequency of testing
- Frequency of data assessment
- Frequency of reporting
- Relevance of measurements

A management system can be killed by too much meaningless data. Too many measurements require time and effort and are the first thing to be neglected when time is limited. A few measurements that can be done quickly and accurately and that have a meaningful input on the decision-making process, should be selected.

The most appropriate measurements that can be done on the farm are pH and EC. Although the EC measurement cannot tell what type of salts is dissolved, in a management system it can tell the magnitude of changes. Comparing the latest EC measurement with that on record, including that of the laboratory report, indicates changes and whether additional actions or tests are justified. A hand-held module pH-meter or pH strips and an EC-meter that can be used in the orchards with ease should be available. Follow the instructions of the supplier to ensure accuracy.

Record the data immediately and/or transfer it to the data base for water management. The concentration of suspended solids in the water is another simple measurement that can be included in the management system. Other important measurements are the concentration of sodium, chloride and boron, as well as the SAR. These can only be done in a laboratory and should form part of the report on the complete analyses of the water.

The quality of a water quality management system (WQMS) depends on what is done with the data and not how much data is collected. Collect data that can be used to optimise the production of citrus in a sustainable environment.

Accuracy of the measurements

Measurements on the farm and in the orchard cannot be as accurate as those done in a laboratory. However, on-farm measurements should be accurate enough to give results similar to that of the laboratory. The procedures used on the farm should also include standard solutions for pH (pH-buffers) and EC. However, always strive to measure as accurately as possible without increasing the cost too much. Hand-held instruments that are calibrated regularly are usually very accurate. Laboratory results should be of a high standard.

Frequency of testing

The quality and the variation in quality will dictate the frequency of testing. Water from a huge storage dam, such as the Gariep or Kwena dams, have a fairly constant composition and the frequency of testing will be low. The quality of irrigation water in a river like the Olifants River in the Lowveld is subjected to more fluctuations and will necessitate frequent testing. Historical data can be used to determine the frequency required to optimise WQM. If no data is available, start with a complete laboratory testing followed by weekly testing of pH and EC on the farm until enough data is collected to set a schedule.

Frequency of data assessment

Data is collected to optimise the application of the water. If it is not analysed and evaluated regularly, the whole WQMS is useless. The very reason for a WQMS is to monitor the quality so that actions can be taken before damage is done to the crop, the trees or the environment. In a sound WQMS, evaluation and assessment of data are done soon after logging the data into the recording system. If any change that can have an impact is detected, it should be reported immediately, even in a formally structured management system.

Frequency of reporting

The reporting system depends on the management on the farm. On a small farming unit where the farm manager is also the water quality manager, reporting on and assessing the collected data can be the same process.

The frequency will also depend on the variations in the quality of the water. With few and insignificant changes, a report on water quality should be filed at least once a year.

Where the quality of the water changes more rapidly, the reporting should be scheduled to avoid disasters, to facilitate corrective or preventative actions and to ensure that the relevant people or department get the message in time.

Maintaining water quality management systems

A WQMS that is of relevance to optimise the irrigation system, production and environment, is maintained almost by the fact that is it being used continuously. When the quality of the water is poor or fluctuate, the operations are dependent on the information. The WQMS forms such an important part of the farming operations that its priority will greatly ensure that the system is maintained.

A system that is only used on an ad hoc basis will let the manager down when it is needed the most. This often happens with constant supply of moderate or good quality water. Under such conditions, the measurements, recordkeeping and evaluations are neglected. For these reasons, a formal schedule should be compiled and senior management should enforce the maintenance thereof by requesting regular reporting according to a fixed schedule.

Fluctuations in the quality of the water depend to a large extent on the activities upstream. This information can also be used to determine the frequency of measurements and reporting. Industries letting effluent into the upstream can cause major fluctuations.

The minimum requirement is a laboratory report twice per annum, before and after the rainy season. Thereafter, the frequency will depend on the quality of the water and the type of irrigation.

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In the third example in section 2 of chapter 2, the management system was neglected and not properly maintained. The problems experienced at that time were due to a poorly maintained system and not to a major change in the quality of the water. This incident could have been prevented if the quality management system, including frequent reporting, was maintained. The cost of replacing 13% of the drippers and the loss in production outweighs the cost of maintaining the WQMS.

Individual formative 3

EFFECTS OF CORRECTIVE ACTIONS

Corrective actions on water quality, supply and integrity

The actions to improve the quality of irrigation water are limited to filtration, disinfection and acidification. At this stage the most important quality factor, the EC or total dissolved solids, can not be improved economically. We can add to the water but, apart from the carbonates and bicarbonates, we cannot remove soluble salts from water economically. Therefore other methods are employed to make unsuitable water more suitable to increase the water supply for irrigation.

The simplest method is to mix waters of a low and high salt content in order to get water with a medium, but acceptable, salt content. If the waters are mixed in equal portions (50:50) the EC of the mix will be half the sum of the two separate EC's.

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Calculating the EC of Mixed Water Source

The EC of source A is 25 and that of Source B 125mSm-1. If these two sources are mixed at equal volumes (one volume of A plus one volume of B), the estimated EC of the mix will be:

1 x 25 + 1 x 125 /2

= 75mSm-1, i.e. good quality water

If the sources are mixed at different ratios, the estimated EC can be calculated as follows:

Volumes of A EC=25 mSm-1	*Volumes of B EC=125 mSm-1*	*Formula*	*Estimated EC mSm-1*
1	1	1 x 25 + 1 x 125 / 1 + 1	75.00
2	1	2 x 25 + 1 x 125 / 2 + 1	58.33
3	1	3 x 25 + 1 x 125 / 3 + 1	50.00
1	3	1 x 25 + 3 x 125 / 1 + 3	100.0

Another fairly simple method is the electron magnetic treatment of hard water. In this process, the surface tension of water is decreased by passing the water through a tube-like instrument constructed of dissimilar metals. The process adds electrons to the water which reduce the surface tension and increase the carrying capacity of the water. Equipment is available in South Africa and installation and maintenance is done according to the specifications of the suppliers.

At this stage it is more important to deal with the salts than to desalt the water. Desalting of irrigation water is currently not cost-effective.

Recommendations for corrective actions

The effects of some recommendations for corrective actions can easily be evaluated, especially those with a direct influence on water quality. Adjusting the pH of water to be applied as a pesticide spray is for instance very easy and is done by merely measuring the pH and drawing a conclusion.

The effects of other recommendations can be quite difficult to evaluate. Evaluating recommendations to counteract the high concentration of chlorides in the water requires other information, such as yield and fruit quality data.

The simplest way to do this, is to list the factor to be improved (what to improve), the "before" measurement (why), the recommendation (how) and the "after" measurement (result).

Evaluating the Effect of Corrective Actions

What	*Why*	*How*	*Result*
pH 8.23	Reduce the pH from 8.23 to increase efficacy of pesticide sprays.	Apply 200ml buffer per 100 litres water buffer Z to reach pH 5.5.	pH of the spray mix = 5.5.
Suspended solids = 85mg per litre.	Moderate clogging hazard.	Filtration.	10mg solids per litre water.
Bacterial count = 15,000 per ml.	Slimes forming a definite hazard.	Chlorinate continuously with 3 mg free chlorine per litre water.	Measured free chlorine at most distant emitter = 2 mg per litre.

A huge component of this evaluation relies on the information that necessitates the action. For instance; research results proved that pesticide A is twice as effective at pH 5.5 as at 7.00 or higher. The WQM must have access to this data supplied by a competent institution.

Recommendations to reduce the impact of the indirect effects of water quality need to be done in conjunction with the person responsible for the fertilisation and soil maintenance programs. Usually these recommendations involve multi-disciplinary inputs and can seldom be evaluated by simplistic measurements.

Reporting on water quality management systems

The importance, frequency and scope of reporting depend on the quality of the water received on the farm or at the orchard. With good quality water, where hardly any improvements or actions to reduce the impact on the trees and soil are required, a laboratory analyses twice per annum will be sufficient. As the water quality gets worse, more attention, actions and measurements are required. Reporting then needs to be more involved and should include assessments, actions and outcomes.

A reporting system should include the following basic elements:

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- The current quality of the water
- Comparisons with previous qualities, i.e. asking the question: Is the quality deteriorating?
- Actions to improve or maintain the quality or limit the impact x Schedule for actions to be taken
- Outcome of the actions

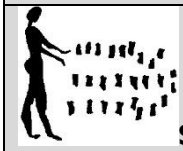
Data for reporting purposes are collected on an ongoing basis according to a planned schedule. The frequency and type of measurements depend on the quality of the water, the irrigation system and soil type.

Reporting on Water Quality

Requirements	***Frequency***	***Measurements***
Laboratory report.	Twice per annum.	Complete analyses for irrigation purposes.
Comparison with historical data.	At least once per annum.	All data on laboratory report and that collected on farm.
List of quality factors that require attention.	Depending on water quality but at least once per annum.	The "before" and "after" measurements.
Report from the advisors on specific inputs.	Whenever an advisor was consulted.	According to the advisors recommendations/report.

The report must be concise and short and should report in detail on quality factors that are important in terms of impact on soil, trees, environment, profitability and sustainability. A prediction of the quality of the water over the next year (short term) and five years (medium term) should be included. If any major actions are required, this should be properly investigated and addressed in the budget.

Individual formative 4



SUMMATIVE 4B

Environmentally Sound Processes

Unit Standard	
116320	Plan and maintain environmentally sound agricultural processes
Specific Outcomes	
SO 1: Plan and maintain sustainable agricultural processes and/or practices taking into account the four components of the environment. SO 2: Demonstrate broad knowledge of the processes of the environment. SO 3: An awareness of the main legal regulations governing agriculture and the environment is demonstrated. SO 4: Understand sustainable agriculture.	
CCFO's	
Identifying	Working Organise

Introduction

Farm management refers to the decisions made by producers- in cooperation with investors and agricultural businesses to be profitable in a sustainable manner. The factors that decisions need to be made about to ensure sustainability, includes resource application, production, marketing and finance. These are considered within the context of the larger external agricultural environment.

Success in farming is a journey full of challenges and opportunities. To be successful in farming, the modern farmer needs to adapt swiftly and with accuracy to an ever-changing larger Agri-economic environment. In this learning unit, we will explore the Agri-economic environment and role-players contributing to activity in this environment.

'Begin with the end in mind'. When a farmer starts with a farming business, it is of utmost importance to plan all actions in such a way as to make optimal use of all resources within the boundaries of sustainability. Every action a farmer takes should contribute towards this end goal, including the management of inputs (natural resources; equipment; human resource; financial; legislative); the processing (planning a farm site; natural resource management plan; optimising farm systems; whole farm management) and the outputs (producing sustainable products for the markets) – this form the framework of this programme in Infrastructure and resource planning:

INPUT	PROCESSES	OUTPUT
OPERATIONAL RESOURCES Buildings (housing, food storage, barn) Machinery (Tractor, ploughs etc) Fencing (incl. tools) Irrigation (water supply, pipes) Electricity NATURAL RESOURCES Soil Plant/vegetation	Whole farming system Natural resource management plan Optimise farming systems Plan a site	Products to markets in a profitable yet sustainable way

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Animals Water		

A HOLISTIC APPROACH

'The whole is more than the individual parts of the whole put together'. To understand this fundamental philosophy behind a holistic approach, we will first ponder on the systems theory.

Systems theory

Systems theory was proposed in the 1936 by the biologist Ludwig von Bertalanffy, and further developed by Ross Ashby von Bertalanffy was both reacting against reductionism and attempting to revive the unity of science. He emphasized that real systems are open to, and interact with, their environments, and that they can acquire qualitatively new properties through emergence, resulting in continual evolution.

Rather than reducing an entity like the human body to the properties of its parts or elements like organs or cells**, systems theory** focuses on the arrangement of and relations between the parts which connect them into a whole, in other words holism. This organization determines a system, which is independent of the concrete substance of the elements (e.g. particles, cells, transistors, people, etc.).

Elements of systems theory are: Input, throughput, feedback, control, environment, goals
The systems view was based on several fundamental ideas.

All phenomena can be viewed as a web of relationships among elements, or a system.
All systems, whether electrical, biological, or social, have common patterns, behaviours, and properties that can be understood and used to develop greater insight into the behaviour of complex phenomena and to move closer toward a unity of the sciences. System philosophy, methodology and application are complementary to this science.

Focussing of farming, we need to learn about the environment as a system, including several farming systems; the farm can also be viewed as a system as you will discover further in this module.

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THE ENVIRONMENT AS A SYSTEM

Viewing the environment as a system, it consists of various elements, referred to as natural resources, being:

- Ground (rocks and soil);
- Water (fresh and sea or marine water);
- Atmosphere (air);
- Fauna (animals and other living beings); and
- Flora (plants)

Each element works within a structured system and in coordination with the other elements to ensure its own survival. **Harmony** and **balance** in the natural environment is **essential** to **life**.

Through understanding how delicate our world is and the importance of harmony and balance, we can learn to maintain all resources on earth and live in a healthy and better world. Sustainable farming practices are achieved by ensuring that all elements in the system co-exist in harmony and balance by implementation of good farming practices.

Individual formative 1

ECOSYSTEM PROCESSES

Managing your farm holistically means to work with nature and not against it. To achieve this, cognisance needs to be taken of the ecosystems existing on the farm, namely:

Community dynamics/systems: The way in which living communities move towards a complex and healthy environment. Living organisms do not develop in a vacuum. Plants require animals and vice versa and both require insects, bacteria and viruses for survival. Any healthy ecosystem can be taken as an example.

Energy cycle or the food chain: the energy from the sun is key to all life on earth and its transfer from one living organism to the next is called the energy cycle. Plant as primary consumers of solar energy. Through photosynthesis, they convert incoming solar radiation into

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organic (carbon based) molecules, feeding themselves and providing food for secondary consumers. Micro-organisms, insects, fish, reptiles, birds, mammals that eat vegetable matter make up these secondary consumers. The cycle continues with each level of consumers feeding from the layer below, forming a pyramid of feeding, some consumers feeding on more than one layer. Plants capture just a fraction of the sun's energy and with each move up the pyramid, less energy is available. This reduction in energy means less total biomass can survive at these higher levels. In other words, predators cannot outnumber prey. At the same time, the lower levels are very unstable if there are insufficient predators in the upper levels, as evidenced by outbreaks of disease or starvation in secondary consumer populations when their numbers get too high.

The water cycle is the movement of water between the atmosphere and the earth. Some water runs off the land to enter streams, rivers, lakes and oceans. In a healthy ecosystem, the soil matrix is capable of absorbing large quantities of moisture. Of the water that is absorbed of the soil, some evaporates back out of the soil, some enters the groundwater, and some is used by the living organisms in the soil, including plants through their roots. In an effective water cycle, water is readily available and used by plants. In an ineffective water cycle, most of the water runs off or evaporates from the soil. The ability to absorb water and bank it for future plant use requires a healthy, living soil that contains plenty of humus or organic matter in the soil. Organic matter is made up of decaying and living organisms. Scientists estimate that tens of millions of living organisms live in a single tablespoon of healthy soil.

The mineral cycle is the breaking down of minerals into a form that can be used by plants and animals. Through this breakdown, essential trace nutrients and minerals are made available to plants and animals. The mineral cycle includes sub cycles, among them the carbon cycle, the nitrogen cycle and the phosphorus cycle.

Carbon is the building block of all life. The implementation of the **carbon cycle** is not gentle or kind: Death is the absolute partner of life. Without death and decay, no new life is possible. When all these cycles are optimised plants and animals thrive. Cycles that no longer operate properly result in increased water runoff, crusting of soil, erosion from both wind and water, and a variety of other symptoms. The extreme example of cycles that have gotten out of balance is seen in desertification, but even in humid environments, which tend to be more forgiving, you will often see the same symptoms.

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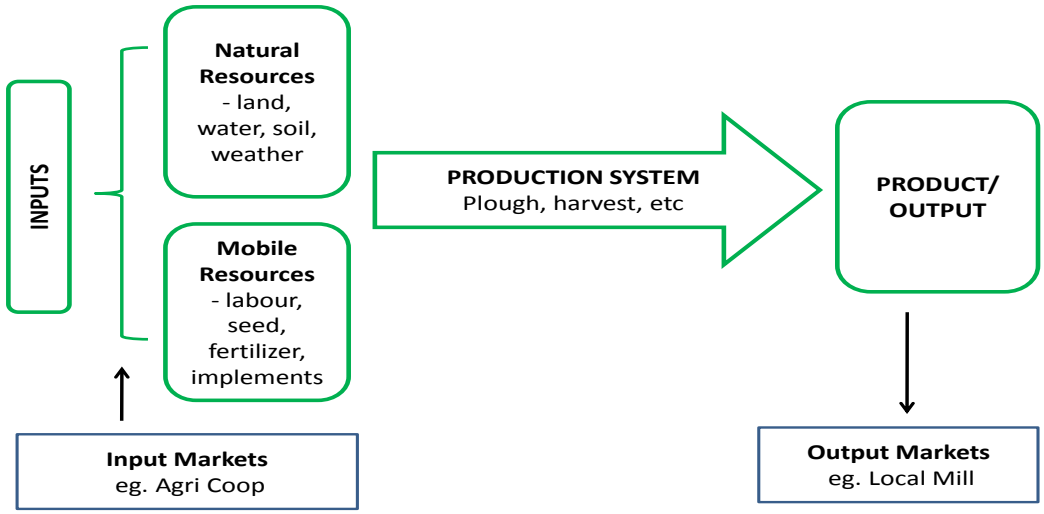
Individual formative 2

FARMING AS A SYSTEM

Farming is an example of a primary industry. Like a factory, a farm is a system of inputs, production and outputs.



INPUT

The **inputs** can be divided into fixed/ natural resources and mobile/ non-fixed resources. Mobile inputs include labour, capital (money), machinery, seeds, fertilizer and other things you would apply to make your crop grow. Natural resource inputs include climate and weather, soil, relief (shape of the land) and slope.

FIXED INPUT – the land

Natural resources are, by definition, limited. More land or more water cannot be produced, and available natural resources must therefore be treated with respect if the farming operation is to be successful. The availability of these resources to meet the long-term needs of the farm is of critical importance.

The potential of a certain site for production depends on its climatic suitability for the varieties to be grown or livestock to be reared and the status of the fixed or natural resources, specifically the availability of sufficient high-quality water and suitable soil. Land and water are scarce, expensive, and must be used efficiently.

Issues to consider when deciding whether land is suitable to produce a specific livestock/crop include:

- Is the land of sufficient size to support the required livestock/ plantings?
- Is the land located in the right climatic area to support the desired livestock/varieties?
- Is the land free from pests and diseases?
- Does the land have sufficient areas of the required soil type and quality?
- Does the land have a sufficient supply of high quality water (as required by the crop/livestock)?
- Is labour available to work the land?
- Is the land situated at an appropriate and manageable distance from the Output market, such as the mill/abattoir?

MOBILE INPUTS: Chemicals; Labour; Machinery

The needs of a farm are to have the maximum yield and make a profit that can be used to grow the farm.

The goods that a farm might require include:

Agro-chemicals

Implements

Packaging material

Parts

These goods are obtained from the Input Market, such as the Agri Coop, the Local Store, etc.

The services that a farm might need include:

Telecommunication

Financial institution's assistance

Irrigation specialists/ Pesticide specialists

Transport Services for goods

Labour

PRODUCTION

The **production system is** the activities that take place on the farm and that can be linked with one another. These may include harvesting, ploughing, rearing animals and milking.

Farms with arable lands are used to grow crops. The farms containing primarily pastures specialise in the rearing of animals. Mixed farms refer to those where more than one product is produced.

PRODUCTION: Farming practices

The farmer wants to achieve the following through his production practices (the way he farms):

- Achieve yield targets;
- Ensure the products meet market quality specifications;
- Farm in such a way that the process is sustainable; and
- Within the framework of Good Agricultural Practices

Environmentally speaking, therefore, production must be managed in such a way that the processes can be used repeatedly throughout the lifespan of the production area (field, orchard) and beyond.
This is achieved by minimizing the use of harmful production practices and applying those that have minimum negative impact on the environment.

Examples of such production practices include:

- Selecting varieties best suited to the environment and climate;
- Using certified nursery material/ seeds;
- Using pesticides with minimum impact on non-target insects;
- Minimizing the use of soil tillage equipment; and
- Accurate and targeted use of fertilizers

Production practices should therefore be carefully managed to achieve the desired production objectives with minimal harmful effects to the environment.

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OUTPUTS

Farming systems can also be classified according to their **outputs/ product.** The output is the product that is delivered through the production process. The product can be sold to the Output Market or consumed by the farmer and his family.

The goods that a farm might offer include:

The product that has been produced.

A processed version of the product that has been produced

A service to the community, e.g., ploughing for other farmers

The output markets

The Buyer

Knowing the output market is essential. The requirements of consumers, wholesalers and retailers (market demand) determine many of the decisions that are taken in respect of production practices. Getting the highest possible return for the product that is produced will ultimately determine the commercial success of the farming operation.

The marketplace to which the farm supplies can be:

Direct to the consumer via farm stalls or direct sales

To the silo/ maize buyer for packing, grading and sorting

The local mill

The consumer

The needs that the consumer has are for high value products at reasonable prices, of consistent quality and that is not damaging to their health.

The needs that a farm might fulfil:

The consumer's hunger

The consumer's request for a specific type of product

The consumer's request for a specific processed product- e.g., maize as chicken feed

Individual formative 3

SUSTAINABLE AGRICULTURE

Sustainable agriculture is one that produces abundant food without depleting the earth's resources or polluting its environment. It is agriculture that follows the principles of nature to develop systems for raising crops and livestock that are, like nature, self-sustaining.

Sustainable agriculture is also the agriculture of social values, one whose success is indistinguishable from vibrant rural communities, rich lives for families on the farms, and wholesome food for everyone.

The WWF report on sustainability in agriculture in SA views agriculture as the foundation of developing economies. As one of these economies, South Africa needs to ensure a healthy agricultural industry that contributes to the country's gross domestic product (GDP), food security, social welfare, job creation and ecotourism, while adding value to raw materials. But the health of the agricultural sector depends on the sustainability of farming methods. Farming practices must therefore not only protect the long-term productivity of the land, but must also ensure profitable yields and the well-being of farmers and farm workers.

Sustainable agriculture is a philosophy as well as a farming system as it has roots in a set of values that reflects a state of awareness of ecological and social realities and one's ability to take preventative action. It also involves the design and management processes that work with natural processes to conserve all resources, minimise waste and environmental impact while maintaining and improving productivity

Sustainable Agriculture combines three main goals:

environmental health
economic profitability,
and social and economic equity.

Sustainability

"Able to be continued indefinitely without a significant negative impact on the environment or its inhabitants."

Sustainability rests on the **principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs**. In other words, we must balance our need for profits, and outputs to satisfy our market, with the need to conserve our natural resources in such a manner that it is not unnecessarily harmed.

But how will we know if what we are doing is sustainable? We need to look at our sustainability indicator measures…

What is a sustainability indicator?

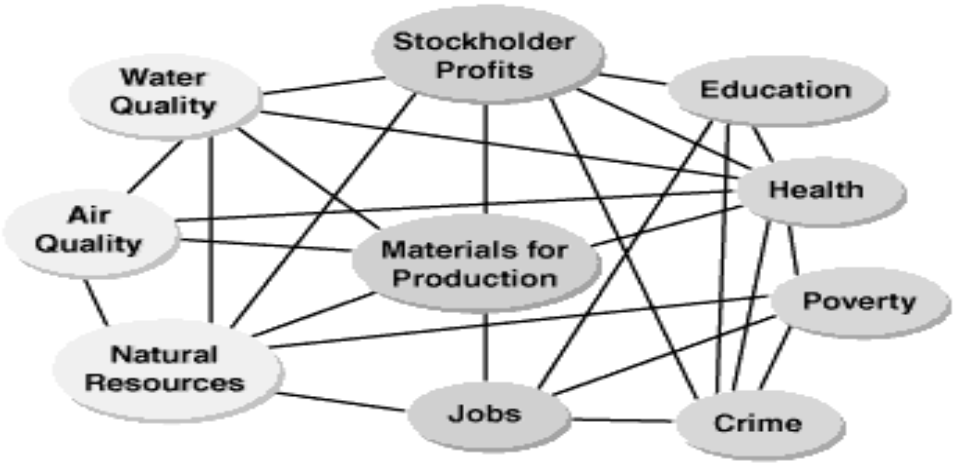
An indicator is something that helps you understand where you are, which way you are going and how far you are from where you want to be.

A good indicator alerts you to a problem before it gets too bad and helps you recognize what needs to be done to fix the problem.

Indicators of a sustainable community point to areas where the links between the economy, environment and society are weak.

They allow you to see where the problem areas are and help show the way to fix those problems.

Indicators of sustainability are different from traditional indicators of economic, social and environmental progress



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What are our social values?

Do we need money more than caring for our environment?

Do we pay attention to erosion, pollution and degradation?

Are we aware of our invasive species of plants and animals?

Are we simply desperate to survive and make some money at all cost?

Are we greedy to make a lot more money than we need without real care for our environment?

Let's look at some "indicators" that would tell you **whether your agri-business is sustainable**. The tables below compare traditional indicators with sustainable community indicators.

Economic/Political Indicators		
Traditional Indicators	**Sustainability Indicators**	**Emphasis of Sustainability Indicators**
Average income	Number of hours of paid employment at the average wage required to support basic needs	What wage can buy Defines basic needs in terms of sustainable consumption
Unemployment rate Number of companies Number of jobs	Diversity and vitality of local job base Number and variability in size of companies Number and variability of industry types Variability of skill levels required for jobs	Resilience of the job market Ability of the job market to be flexible in times of economic change
Environmental Indicators		
Traditional Indicators	**Sustainability Indicators**	**Emphasis of Sustainability Indicators**
Ambient levels of pollution in air and water	Use and generation of toxic materials (both in production and by end user) Vehicle miles travelled	Conservation and cyclical use of materials
Cost of fuel	Total energy used from all sources Ratio of renewable energy used at renewable rate compared to non-renewable energy	Use of resources at sustainable rate

Social Indicators		
Traditional Indicators	**Sustainability Indicators**	**Emphasis of Sustainability**

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		Indicators
Standardized test scores	Number of students trained for jobs that are available in the local economy Number of students who go to college and come back to the community	Matching job skills and training to needs of the local economy
Number of registered voters	Number of voters who vote in elections Number of voters who attend town meetings	Participation in democratic process Ability to participate in the democratic process

Individual formative 4

LEGISLATION IMPACTING ON SUSTAINABILITY

The employment of resources in farming operations must be compliant with legislative requirements. These legal requirements, which are promulgated as acts of parliament, effectively place boundaries on the various production and marketing activities and how they are conducted. The following are examples of some of the activities and the related Act(s):

Environmental conservation
- *Conservation of Agricultural Resources Act of 1983*
- *National Environmental Management Act of 1998,*
- *Plant Improvement Act*

Minimum fruit quality standards for local and export products
- *Agricultural Products Standards Act of 1990*

Health and safety, and good agricultural practices
- *Health Act of 1977, Fertilizers*
- *Farm Feeds, Agricultural Remedies and Stock Remedies Act of 1947*
- *Agricultural Pests Act 1983,*
- *Occupational Health and Safety Act*

Marketing of agricultural products
- *Marketing of Agricultural Products Act (Amended) of 2001*
- *Agricultural Produce Agents Act*

Agricultural research
- *Agricultural Research Amendment Act of 2001*
- *National Advisory Council on Innovation Act of 1997*

Technical advisory activities
- *Natural Scientific Professions Act 0f 1993*

Equity and fair labour practices
- *Employment Equity Act of 1998*
- *Basic Conditions of Employment Act*
- *Sectoral Determination 13*
- *The Land Reform Act (Labour Tenants) of 1996*

Farmers should be aware of the key requirements of these and other relevant legislation when developing strategy and operating the farm. Compliance with the requirements may involve costs that must be factored into the budget and non-compliance may lead to fines or even imprisonment.

GROUP Activity 5

Natural Resources in an agricultural context

Conservation

Conservation is the sustainable use of natural resources, such as soils, water, plants, animals, and minerals. In economic terms, the natural resources of any area constitute its basic capital and wasteful use of those resources constitutes an economic loss. From the aesthetic and moral viewpoint, conservation also includes the maintenance of national parks, wilderness

areas, historic sites and wildlife. In certain cases, conservation may imply the protection of a natural environment from any human economic activity. Natural resources are of two main types, renewable and non-renewable. Renewable resources include wildlife and natural vegetation of all kinds. The soil itself can be considered a renewable resource, although severe damage is difficult to repair because of the slow rate of soil-forming processes. The natural drainage of waters from the watershed of a region can be maintained indefinitely by careful management of vegetation and soils, and the quality of water can be controlled through pollution control. (See Air Pollution, Environment, Reclamation, Sewage Disposal, Water Pollution and Energy Conservation :) Non-renewable resources are those that cannot be replaced or that can be replaced only over extremely long periods of time. Such resources include the fossil fuels (coal, petroleum, and natural gas) and the metallic and other ores. For discussions of conservation problems in this area, see individual entries on the substances concerned.

History

Although the conservation of natural resources has been recognised as desirable by many peoples since ancient times, frequently the basic principles of sound land use have been ignored with disastrous results. Major losses, for example, the silting of rivers and the flooding of lowlands, resulted from the destruction of the forests and grasslands that protected watersheds in northern China and the Tigris-Euphrates area. Large areas in North Africa and the Middle East were rendered barren by centuries of uncontrolled livestock grazing, unwise cultivation, and excessive cutting of woody plants for fuel. Similar damage has also occurred in most of the more recently developed regions of the world, sometimes through the unwise introduction of species into new environments. The increasing industrialisation of nations around the world continues to present severe conservation problems although international cooperation efforts have also evolved in certain areas, such as the protection of some endangered species. Some basic conservation principles in major areas of concern are discussed below.

Conservation of grazing lands

One of the principles of range conservation is the use of only a portion (usually about a half) of the annual forage-plant production of a particular range in order to maintain healthy plant growth and reproduction. In addition, each range is stocked with the number of animals that can be nourished properly on the available usable forage and are permitted to graze only

during the season suitable for that type of range. The conservation of ranges is based on a programme of grazing designed to keep them productive indefinitely and to improve depleted areas by natural reproduction or by artificial seeding with appropriate forage species. Although these principles are well established, many hundreds of thousands of acres of public grazing lands are still overgrazed.

Wildlife conservation

One of the basic principles of wildlife conservation involves providing adequate natural food and shelter to maintain populations of each species in a given habitat. A major threat facing wildlife is both the destruction of habitat, through drainage, agriculture and urban expansion, and the fragmentation of habitat into parcels too small for wildlife populations to use. Illegal trade in feathers, horns, ivory, hides, and organs has brought many endangered species to the verge of extinction. Wildlife is an important biological, economic, and recreational resource that can be maintained through careful management. Hunting regulations allow the culling of many species without affecting overall population levels, and can even help control species that have grown too abundant for the region they inhabit.

Soil conservation

Strip-cropping;

In order to preserve their farmlands, many farmers uses the stripcropping method as seen here. By alternating strips of cultivated crops with strips of sod-forming crops, the farmer can relieve the effects of erosion. (Soil Conservation Service)

Among the basic measures for soil conservation currently in use is the zoning of land by capability classes. In this system the more level and stable soils are designated as suitable for annual crops, and other areas are designated for perennials, such as grass and legumes, or for use as grazing or forest lands.

Another conservation method involves the use of soil-building plants in crop rotations. Such crops hold and protect the soil during growth and, when ploughed under, supply much-needed organic matter to the soil.

Cultivation methods that leave a layer of vegetable waste on the surface of the soil represent a major advance in land use. In many areas these techniques have supplanted the use of the

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mouldboard plough, associated with the practice known as clean cultivation, which left the soil surface exposed to all the natural erosive forces.

Special methods for erosion control include contour farming, in which cultivation follows the contours of sloping lands, ditches and terraces are constructed to diminish the run-off of water. Another soil-conservation method is the use of strip-cropping—that is, alternating strips of crop and fallow land. This method is valuable for control of wind erosion on semi-arid lands that need to lie fallow for efficient crop production. In addition, the maintenance of soil fertility at the maximum level of production often involves the use of inorganic (chemical) fertilisers.

Renewable Energy

Renewable Energy is energy present in the natural flows of wind, water, and sunlight in the environment and that is continually replenished as quickly as it is extracted and used. Renewable energy will therefore never run out.

The importance of renewable energy

Most of the energy sources on Earth originate from the Sun, with the exceptions of the energy in the tides, caused by the gravitational pull of the Moon and Sun, and geothermal energy, which results from the heat escaping from hot rocks 2 km (1.2 mi) below the Earth's surface and from the effects of radioactive decay. The Sun's radiation is equivalent to 1.4 kW/sq mi in space before any attenuation due to travelling through the Earth's atmosphere. This solar radiation is converted naturally into various energy streams. Wave energy results from the interaction between the convection-driven winds and the surface of the sea; hydro-energy is produced by the hydrological cycle; and biological energy (biomass energy) is that which is stored in living organisms by the process of photosynthesis. All these forms of energy are available as renewable resources because of the continual replacement of the energy on a daily, or even hourly, basis. By way of contrast, fossil fuels such as coal, oil, and gas, although originally laid down effectively as biomass, take millions of years to form and need to be regarded as finite, non-renewable resources.

The Fundamental Energy Resource: the sun. Solar energy strikes the surface of the Earth at the rate of 120,000 TW (Terawatts; 1 TW equals 1012 Watts) or 10,000 times the current global energy demand. Although a large proportion of this energy is radiated back into space,

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approximately one third of this energy is converted by the hydrological cycle into heat, a smaller proportion into wind and waves, and about 30 TW is converted into biomass.

	Summative 4C

Unit 5: Read and Analyse Text

Unit Standard	
119469	Read/view, analyse and respond to a variety of texts
Specific Outcomes	
SO 1: Critically analyse texts produced for a range of purposes, audiences and contexts. SO 2: Identify and explain the values, attitudes and assumptions in texts. SO 3: An awareness of the main legal regulations governing agriculture and the environment is demonstrated. SO 4: Evaluate the effects of content, language and style on readers'/viewers' responses in specific texts.	
CCFO's	

Identifying	Working	Organise
Collecting	Communicating	Science
Demonstrating	Contributing	

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Introduction

Every act of creation is first of all an act of destruction" – Pablo Picasso, Artist

PROGRAMME OVERVIEW

The foundation of lasting self-confidence and self-esteem is excellence, mastery of your work. The purpose of this unit standard is to use analytical skills to make informed judgements about complex human and social issues. You will become aware of both the functions of language and of its drama and power. You will learn how to be a critical, reflective reader and viewer of written and visual text. You will be able to draw comparisons between texts, and to compare and contrast themes and issues in texts with those in the contexts in which they live and work. You will be able to identify and analyse style and tone and account for their effectiveness in different texts. You will be willing to challenge the assumptions and values expressed in texts.

Analysing and criticizing texts – Reading strategies

Skimming and scanning

Skimming involves searching for the main ideas by reading the first and last paragraphs, noting other organizational cues, such as summaries, used by the author.

In order to skim:

- Formulate questions before you begin e.g. what is this all about? Does this article deal with the subject I am researching?
- Read FAST bearing in mind your question(s).
- Do NOT read every word.
- Look at the opening paragraph of each chapter or section.
- Read the first sentence in each paragraph.
- Try to catch key phrases.

Scanning involves running your eyes down the page looking for specific facts or key words and phrases.

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Think about what FORM the information will take: Is it a number? Is the word in capitals? How does it start?

- VISUALISE what the word or number looks like
- Use numerical order
- Do NOT read every word/number
- Read FAST and when you find the information you want then you slow down and examine it closely

Skimming and scanning are particularly valuable techniques for studying scientific textbooks. Science writers pack many facts and details closely together, and learners react by shifting their reading speeds to the lowest gear and crawling through the material. Notwithstanding the fact that science textbooks are usually well-organized, with main points and sub-topics clearly delineated, the typical learner ignores these clues and plods through the chapter word-by-word, trying to cram it all in. It is precisely these characteristics, organization and densities of facts per page that make it so vital that you employ skimming scanning techniques. To successfully master science test, you must understand thoroughly the major ideas and concepts presented. Without such a conceptual framework, you will find yourself faced with the impossible task of trying to cram hundreds of isolated facts into your memory.

Thus, a preliminary skimming for the main ideas by using the author's organization cues (Topic headings, italics, summaries, etc.) is a vital preliminary step to more intensive reading and maximum retention. It will provide a logical framework in which to fit the details. Similarly, scanning skills are valuable for several purposes in studying science. First, they are an aid in locating new terms, which are introduced in the chapter. Unless you understand the new terms, it is impossible to follow the author's reasoning without dictionary or glossary.

Thus, a preliminary scanning of the chapters will alert you to the new terms and concepts and their sequence. When you locate a new term, try to find its definition. If you are not able to figure out the meaning, then look it up in the glossary or dictionary. (Note: usually new terms are defined as they are introduced in science texts. If your text does not have a glossary, it is a good idea to keep a glossary of your own in the front page of the book. Record the terms and their definition or the page number where the definition is located. This is an excellent aid to refer to when you are reviewing for an examination, as it provides a convenient outline of the course). Secondly, scanning is useful in locating statements, definitions, formulas, etc. which

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you must remember completely and precisely. Scan to find the exact and complete statement of a chemical law, the formula of a particular compound in chemistry, or the stages of cell division. Also, scan the charts and figures, for they usually summarize in graphic form the major ideas and facts of the chapter. If you practice these skimming and scanning techniques prior to reading a science chapter, you will find that not only will your intensive reading take much less time, but that your retention of the important course details will greatly improve.

Concentrating and reading

Learners often complain that they read but cannot remember what they have read. The reason for this is probably that they did not adapt their STYLE of reading to suit the type of text and purpose for reading. Make sure you stay alert whilst reading. Hold a soft pencil (2B) and MARK your textbook. This involves UNDERLINING key words and phrases. It is best to read a paragraph first and then underline when you read it again.

Marking a textbook may involve the following:

- Writing summary words or phrases in the margin.
- Circling words for which you don't know the meaning
- Marking definitions
- Numbering lists of ideas, cases, reasons, and so forth x Placing asterisks next to important passages
- Putting question marks next to confusing passages
- Marking notes to yourself like "check" "re-read", or "good test item"
- Drawing arrows to show relationships
- Drawing summary charts or diagrams

YOUR CODE - Develop your own codes. Here are some ideas:

SYMBOL MEANING
e.g. – example
def – definition
* – important message
T – good test question
?? – confusing

C – check later

RR – re-read

sum – summary statement

What counts as reading?

Reading is something we do with books and other print materials, certainly, but we also read things like the sky when we want to know what the weather is doing, someone's expression or body language when we want to know what someone is thinking or feeling, or an unpredictable situation so we'll know what the best course of action is. As well as reading to gather information, "reading" can mean such diverse things as interpreting, analysing, or attempting to make predictions.

What counts as a text?

When we think of a text, we may think of words in print, but a text can be anything from a road map to a movie. Some have expanded the meaning of "text" to include anything that can be read, interpreted or analysed. So, a painting can be a text to interpret for some meaning it holds, and a mall can be a text to be analysed to find out how modern teenagers behave in their free time.

How do readers read?

Those who study the way readers read have come up with some different theories about how readers make meaning from the texts they read. Being aware of how readers read is important so that you can become a more critical reader. In fact, you may discover that you are already a critical reader.

The Reading Equation

Cognitive Reading Theory

The reading equation

Prior Knowledge + Predictions = Comprehension

When we read, we don't decipher every word on the page for its individual meaning. We process text in chunks, and we also employ other "tricks" to help us make meaning out of so many individual words in a text we are reading. First, we bring prior knowledge to everything we read, whether we are aware of it or not. Titles of texts, authors' names, and the topic of the piece all trigger prior knowledge in us. The more prior knowledge we have, the better prepared we are to make meaning of the text. With prior knowledge we make predictions, or

guesses about how what we are reading relates to our prior experience. We also make predictions about what meaning the text will convey.

- Tapping into Prior Knowledge
- Making Predictions
- How Reaching Comprehension Make Us Better Writers

Tapping into prior knowledge

It's important to tap into your prior knowledge of subject before you read about it. Writing an entry in your writer's notebook may be a good way to access this prior knowledge. Discussing the subject with classmates before you read is also a good idea. Tapping into prior knowledge will allow you to approach a piece of writing with more ways to create comprehension than if you start reading "cold."

Making predictions

Whether you realize it or not, you are always making guesses about what you will encounter next in a text. Making predictions about where a text is headed is an important part of the comprehension equation. It's all right to make wrong guesses about what a text will do – wrong guesses are just as much a part of the meaning-making process of reading as right guesses are.

How can comprehension make us better writers?

When you have successfully comprehended the text you are reading, you should take this comprehension one step further and try to apply it to your writing process. Good writers know that readers have to work to make meaning of texts, so they will try to make the reader's journey through the text as effortless as possible. As a writer you can help readers tap into prior knowledge by clearly outlining your intent in the introduction of your paper and making use of your own personal experience. You can help readers make accurate guesses by employing clear organization and using clear transitions in your paper.

Cognitive reading theory

When you read, you may think you are decoding a message that a writer has encoded into a text. Error in reading comprehension, in this model, would occur if you as a reader were not decoding the message correctly, or if the writer was not encoding the message accurately or

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clearly. The writer, however, would have the responsibility of getting the message into the text, and the reader would assume a passive role.

According to this view:

- Reading has a Model
- Reading is an Active, Constructive, Meaning-Making Process
- Reading is Multi-Level
- Reading is Hypothesis Based
- Reading is strategic

Reading has a model

Let's look at a more recent and widely accepted model of reading that is based on cognitive psychology and schema theory. In this model, the reader is an active participant who has an important interpretive function in the reading process. In other words, in the cognitive model you as a reader are more than a passive participant who receives information while an active text makes itself and its meanings known to you. Actually, the act of reading is a push and pull between reader and text. As a reader, you actively make, or construct, meaning; what you bring to the text is at least as important as the text itself.

Reading is an active, constructive, meaning-making process

Readers construct a meaning they can create from a text, so that "what a text means" can differ from reader to reader. Readers construct meaning based not only on the visual cues in the text (the words and format of the page itself) but also based on non-visual information such as all the knowledge readers already have in their heads about the world, their experience with reading as an activity, and, especially, what they know about reading different kinds of writing. This kind of nonvisual information that readers bring with them before they even encounter the text is far more potent than the actual words on the page.

Reading is multi-level

When we read a text, we pick up visual cues based on font size and clarity, the presence or absence of "pictures," spelling, syntax, discourse cues, and topic. In other words, we integrate data from a text including its smallest and most discrete features as well as its largest, most abstract features. Usually, we don't even know we're integrating data from all these levels. In addition, data from the text is being integrated with what we already know from our

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experience in the world about all fonts, pictures, spelling, syntax, discourse, and the topic more generally. No wonder reading is so complex!

Reading is hypothesis based

In yet another layer of complexity, readers also create for themselves an idea of what the text is about before they read it. In reading, prediction is much more important than decoding. In fact, if we had to read each letter and word, we couldn't possibly remember the letters and words long enough to put them all together to make sense of a sentence. And reading larger chunks than sentences would be absolutely impossible with our limited short-term memories.

So, instead of looking at each word and figuring out what it "means," readers rely on all their language and discourse knowledge to predict what a text is about. Then we sample the text to confirm, revise, or discard that hypothesis. More highly structured texts with topic sentences and lots of forecasting features are easier to hypothesize about; they're also easier to learn information from. Less structured texts that allow lots of room for predictions (and revised and discarded hypotheses) give more room for creative meanings constructed by readers. Thus, we get office memos or textbooks or entertaining novels.

Reading is strategic

We change our reading strategies (processes) depending on why we're reading. If we are reading an instruction manual, we usually read one step at a time and then try to do whatever the instructions tell us. If we are reading a novel, we don't tend to read for informative details. If we a reading a biology textbook, we read for understanding both of concepts and details (particularly if we expected to be tested over our comprehension of the material.) Our goals for reading will affect the way we read a text. Not only do we read for the intended message, but we also construct a meaning that is valuable in terms of our purpose for reading the text. Strategic reading also allows us to speed up or slow down, depending on our goals for reading (e.g. scanning newspaper headlines v. Carefully perusing a feature story).

Genres

We say a poem, novel, story, or other literary work belongs to a particular genre if it shares at least a few conventions, or standard characteristics, with other works in that genre. For example, works in the Gothic genre often feature supernatural elements, attempts to horrify the reader, and dark, foreboding settings, particularly very old castles or mansions. There are

two main types of reading material – fiction and non-fiction. Both types may be further divided into genres. A genre is simply a fancy name for a group of books which share style, form, or content. Is that as clear as mud? Well, read on, you'll get it.

Non-fiction genre

All of the information in a non-fiction book is based on the known true facts. Nothing can be made up. Non-fiction books include how-to books, science books, history books, biographies, autobiographies and much more. Non-fiction books can be about any subject.

Fiction genres

Fictional stories may be based on actual events or people or may be based entirely on the author's imagination, but fictional stories all contain elements that are made up or created by the author.

Realistic fiction - Fictional stories that take place in modern time, right here and now. The characters are involved in events that could really happen.

Mystery - Fictional stories about a mysterious event, which is not explained, or a crime that is not solved until the end of the story, to keep the reader in suspense. x Fantasy Fiction that contains elements that are NOT realistic, such as talking animals, magical powers, etc. Make-believe is what this genre is all about. x Science Fiction Stories that include futuristic technology; a blend of scientific fact and fictional elements.

Historical Fiction - Stories which take place in a particular time period in the past. Often the basic setting is real, but the characters are fictional.

Folk Tales, Tall Tales, and Fairy Tales - Folk tales are stories with no known creator. They were originally passed down from one generation to another by word of mouth. The authors on folk tale books today are retelling these stories. Although, folk tales are sometimes based on real historical figures, there are fictional elements to the story. Tall tales are generally folk tales in which the main character is bigger than life in some way – examples would be Paul Bunyan, Mike Fink, Swamp Angel, etc. Fairy tales were often created to teach children behaviour in an entertaining way. Folk tales, tall tales, and fairy tales are found in most libraries in the non-fiction section with a Dewey Decimal Classification of 398. Some libraries place picture book versions of folk tales in the easy book section.

Myths - Myths are stories that usually explain something about the world and involve gods and other supernatural beings. Although, myths are fictional stories, in most libraries they are found in the non-fiction section of the library in the 290s.

Poetry - Poetry is verse written to create a response of thought and feeling from the reader. It often uses rhythm and rhyme to help convey its meaning. Poetry collections are usually found in the non-fiction section of the library under the Dewey Decimal Classification numbers 808 - 811. Occasionally a novel may be written in free verse form and is found in the fiction section of the library, or a picture book of a poem may be found in the easy section.

Biography - A biography is the story of a real person's life, written or told by another person. Biographies may be located in a section of their own in some libraries and may be labelled B for biography or use the Dewy Decimal System Classification number of 92 and then are listed in alphabetical order according the name of the person, which the book is about. Biographies of 2 or more people in the same book use the Dewey Classification number of 920.

Autobiography - An autobiography is the story of a real person's life, written or told by that person. Autobiographies are found in the same place as the biographies in the library. See biographies for the different places you might find autobiographies in your library and then check with your librarian if you can't find them in your library.

Textbook preview

Most of the books learners are required to read in learnerships are textbooks – books that summarize information about the subject matter of a learnership course. This unit standard emphasizes how to read textbooks because, if you are a full-time learnership learner, you will usually need to read, study, and learn the information in five or more textbooks each term. The first step in reading a textbook is to acquire a quick overview of its contents by surveying it in the way summarized in "How to Preview a Textbook". A preview provides you with an overview of a book and helps you to orient yourself for reading and studying it.

How to Preview a Textbook

Before you read a textbook, examine the features in the front and back of the book.

Preview the front of the book

- Read the title page to learn the title, author (or authors), and publisher of the book.
- Read the copyright page to find out what year the book was published.
- Read the table of contents to get an overview of the organization of the book and the major topics discussed in it.
- Read the preface or introduction to find out whether it describes special features that are provided in the book to help learners learn.

Preview the back of the book

- Determine whether an appendix follows the last chapter; if it is, find out what is in the appendix.
- Check to see if there is a glossary at the end of the book or if there are short glossaries in each chapter.
- Determine whether references are listed at the end of the book or at the end of each chapter.
- Determine whether there is an index at the end of the book or if the book has a subject index and a name index.

The title page

Begin a preview by reading the title page. It gives exact information about the title of a book, the author or authors, the publisher, and the city in which the book was published. The title page is usually the second or third page in a book. When the title of a book is not followed by an edition number, it is the first edition and when more than one city is listed on a title page; the book was published in the first city listed.

The copyright page

After you have read the title page, read the page that follows it-the copyright page. A copyright page tells when a book was published. When more than one year is listed in the copyright information, the book was published in the most recent year listed. The copyright year tells you whether the information in a book is sufficiently up to date for your purposes. For instance, if you want to learn about the current tax laws of the United States, you will want to read a book with a very recent copyright date. On the other hand, if you want to learn how to give a speech, a book published ten years ago may give information that is sufficiently up to date for this purpose.

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Table of contents

Continue your preview by reading the table of contents, which provides an overview of the organization of a book and the major topics discussed in it. When a table of contents does not follow the copyright page, look for it, following the preface or introduction.

The preface/foreword or introduction

A preface/foreword or an introduction explains why a book was written; it usually presents information about the purpose, philosophy, or contents of a book, and it often describes special features that are provided to help learners learn information in the book. These opening remarks are usually located on pages following the table of contents, but sometimes they appear before the table of contents. Most books have either a preface or a foreword or an introduction; some books have both.

The appendix

An appendix, which contains supplementary material, is usually located immediately after the last chapter. An appendix in a chemistry textbook may present an overview of the mathematics important to know in chemistry, and an appendix in an English textbook may explain how to punctuate and capitalize when writing. However, many textbooks have no appendix.

The glossary

A glossary is an alphabetically arranged list of important words and their definitions. When a glossary is included in a book, it is usually located after the last chapter or after the appendix. A textbook that has no glossary at the end may have short glossaries at the end of each chapter.

The references

The references, a bibliography, or notes are lists of publications and other sources that an author quotes or refers to in a book. References are usually listed at the end of a textbook, following the glossary or last chapter. When they are not at the end of a book, they may be listed at the end of each chapter. Textbooks for subjects such as English, speech, and mathematics usually have no references.

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The index

An index is an alphabetically arranged list of subjects and the numbers of the pages on which the subjects are discussed in a book. When an index is included in a book, it is on the very last pages. Some books have two indexes: a subject index and a name index, or author index. When a name index (or author index) is included in a book, it is located before the subject index. If you do not find the name of a person in an index, look to see if the book has a name index.

Chapter preview

One of the most common assignments in learnerships is to read a chapter of a textbook. Most learners undertake this kind of assignment by turning to the first page of a chapter and reading it through to the last page. This is not an efficient way to read and study the chapters in textbooks. Experienced learners know that it is more effective to preview a chapter before reading it. When you preview a chapter, you learn things that make it possible for you to read the chapter with greater understanding. Read "How to Preview a Chapter".

How to Preview a Chapter Use the following steps to preview a chapter before you read it:

1. Preview the beginning of a chapter.
    - Read the title and introduction to learn the topic and purpose of the chapter.
    - If there are learning goals at the beginning of the chapter, read them to find out what you are supposed to learn when you study the chapter.
2. Preview the body of the chapter.
    - Read the headings throughout the chapter to find out what topics are discussed in it.
    - Examine graphs, diagrams, pictures, cartoons, and other visual material in the chapter.
    - Scan any inserts or marginal notes.
3. Preview the end of the chapter.
    - If there is an easy-to-understand summary at the end of the chapter, read it to get a quick overview of the important information or ideas discussed in the chapter.
    - If terminology is listed at the end of the chapter, read it to find out what new words you are supposed to learn when you study the chapter.
    - If there are review questions at the end of the chapter, read them to get an idea of the types of questions you may have to answer about chapter content when you take a test.

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- If there are exercises or problems at the end of the chapter, read them to understand what skills you are expected to learn when you study the chapter.

Title and Introduction

Begin a preview by reading the chapter title and the introduction to the chapter. The title and introduction should summarize what the chapter is about, and an introduction may state the main purpose of the chapter. Whether an introduction to a chapter is short or long, read it carefully as part of your preview.

Headings

Continue a chapter preview by reading the headings to learn what topics are discussed in the chapter. Textbook designers use a variety of methods to show the relationships between headings.

- The size of a heading indicates its importance; the larger the heading, the more important it is.
- A heading in boldface or a special colour (such as red) is more important than a heading of the same size that is not in boldface or a special colour.
- A heading printed above a paragraph is more important than a heading printed on the first line of a paragraph.

The Opening Chapter

The first chapter of a textbook is one of the most important. Here the author sets the stage for what is to follow. At first glance, the first chapter may not seem to say much, and you may be tempted to skip it. Actually, the opening chapter deserves close attention. It presents the framework for the text. More important, it introduces the important terminology used throughout the text. Typically, you can expect to find as many as forty to sixty new words introduced and defined in the first chapter. These words are the language of the course, so to speak. To be successful in any new subject area, it is essential to learn to read and speak its language.

Typographical Aids

Textbooks contain various typographical aids (arrangements or types of print) that make it easy to pick out what is important to learn and remember. These include the following:

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1. Italic type (slanted print) is often used to call attention to a particular word or phrase. Often new terms are printed in italics in the sentence in which they are defined.
2. Enumeration refers to the numbering or lettering of facts and ideas within a paragraph. It is used to emphasize key ideas and to make them easy to locate.
3. Headings and subheadings divide the chapters into sections and label the major topic of each section. Basically, they tell in advance what each section will be about. When read in order, the headings and subheadings form a brief outline of the chapter.
4. Colour print is used in some texts to emphasize important ideas or definitions.

How textbook chapters are organised

You can easily feel lost and confused when reading textbook chapters, too. A chapter can seem like a huge, disorganized collection of facts, ideas, numbers, dates, and events to be memorized. Actually, a textbook chapter is, in one respect, much like a large supermarket. It, too, has signs that identify what is located in each section. These signs are the headings that divide the chapter into topics. Underneath each heading, similar ideas are grouped together, just as similar products are grouped together in a supermarket. Sometimes a group of similar or related ideas is labelled by a subheading (usually set in smaller type than the heading and/or indented differently). In most cases, several paragraphs come under one heading.

In this way chapters take a major idea, break it into its important parts, and then break those parts into smaller parts. Notice that this chapter has three major headings and that the first major heading is divided into eight subheadings. Since the chapter is divided into three major headings, you know that it covers three major topics. You can also tell that the first major heading discusses eight types of textbook aids. Of course, the number of major headings, subheadings, and paragraphs under each will vary from chapter to chapter in a book. When you know how a chapter is organized, you can use this knowledge to guide your reading. Once you are familiar with the structure, you will also begin to see how ideas are connected. The chapter will then seem orderly, moving from one idea to the next in a logical fashion.

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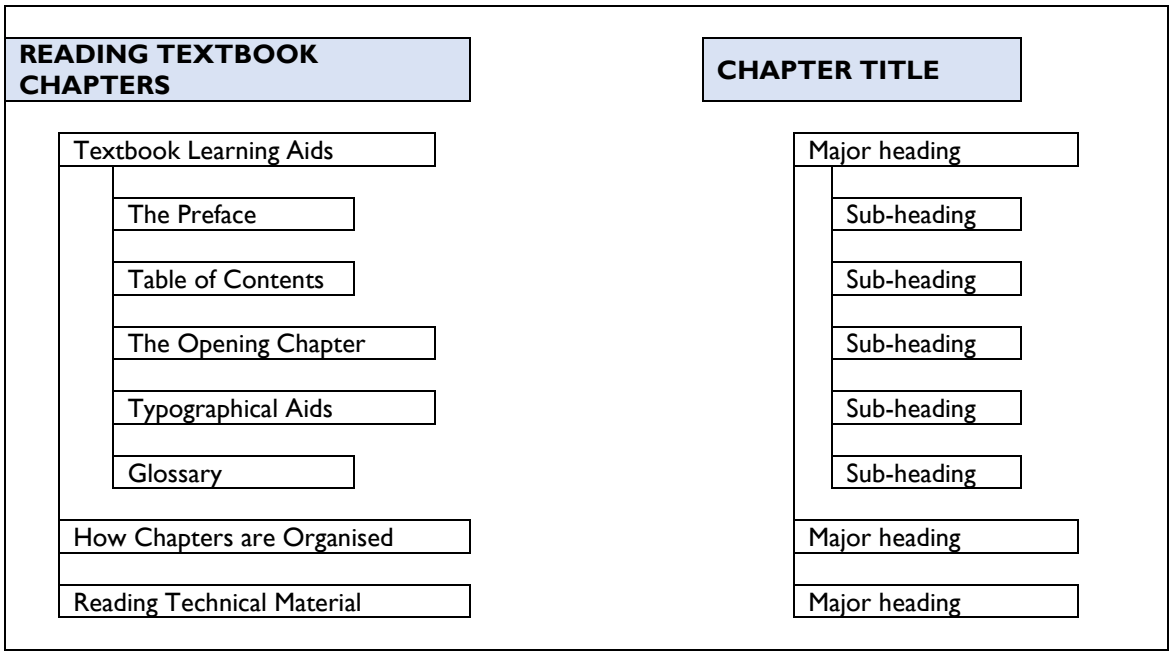

A general approach to graphics

Graphics include tables, charts, graphs, diagrams, photographs, and maps. Here is a general step-by-step approach to reading graphics.

1. Read the title or caption. The title will identify the subject and may suggest what relationship is being described.
2. Discover how the graphic is organized. Read the column headings or labels on the horizontal and vertical axes.
3. Identify the variables. Decide what comparisons are being made or what relationship is being described.
4. Analyse the purpose. Based on what you have seen, predict what the graphic is intended to show. Is its purpose to show change over time, describe a process, compare costs, or present statistics?
5. Determine scale, values, or units of measurement. The scale is the ratio that a graphic has to the thing it represents. For example, a map may be scaled so that one-inch on the map represents one mile.
6. Study the data to identify trends or patterns. Note changes, unusual statistics, unexplained variations.

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7. Read the graphic along with corresponding text. Refer to the paragraphs that discuss the graphic. These paragraphs may explain certain features of the graphic and identify trends or patterns.
8. Make a brief summary note. In the margin, jot a brief note summarizing the trend or pattern the graphic emphasizes. Writing will crystallize the idea in your mind and your note will be useful for reviewing.

Graphic communication is communication using devices such as tables, bar graphs, line graphs, cartoons, pictures and pictograms. These graphic devices often combine numbers, shapes and words. They are sometimes called non-verbal communication. However, this book defines them as graphics and graphic communication because words are often included. The term non-verbal communication should be reserved for the type of communication called body language. Graphic devices are very useful for showing relationships that would take a great deal of writing to explain. They give a quick visual impression and help readers to compare amounts easily. Good visuals have a greater impact than just the written or spoken word on its own. Graphic devices should be properly integrated into a text. Each graphic should be placed into the text where it is needed. It should be introduced, and should then be analysed below, once the reader has had an opportunity to examine it.

The purposes of graphic devices

Graphic devices help senders to communicate more effectively. They:

- Show groups of numbers that would be very difficult to show in a written message.
- Show relationships that would take many sentences to explain.
- Give a quick visual impression that enables a reader to compare amounts quickly.

These devices include elements that a writer cannot use. These elements include:

- The use of space as in tables.
- The use of shapes, as in bar graphs, illustrations, or pictograms.
- The use of colours to make points stand out.
- The use of lines, as in line graphs and algorithms to show relationships, and stage-by-stage procedures.
- The use of more than one dimension such as length, breadth and even depth.

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Graphic devices have the great advantage that the audience can see all the components and relationships at once. In a written message, on the other hand, the reader has to follow the information in a fixed sequence. Good visuals have a greater impact than just the spoken or written word. A combination of the spoken and visual can be up to twice as powerful as the spoken message on its own. In the same way graphic devices add visual appeal to a written message. They also help to explain difficult ideas, show relationships, simplify and summarize.

Hyperlinks

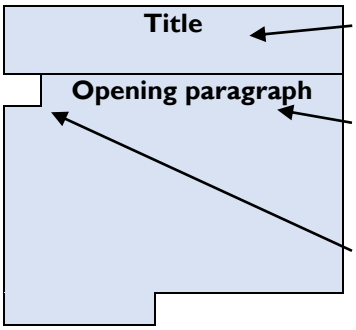
Hyperlinks (often just called links) are the connections between Web pages. Links are the heart of the World Wide Web. Clicking a link takes you from the page you are viewing to another page, or perhaps to an image. Links can also be used to play sounds, movies, or to let you download a file. They are usually text, and are normally displayed as blue, underlined words. The colour of a link changes to purple once you have visited it. This colour change helps you keep track of which links you have and haven't been to.

However, as you surf the Web, you will doubtless run across many variations on the standard approach. Among the most common are image links and image maps. Images are any graphic, ranging from photographs to drawings. Regular images just appear, unadorned, on the Web page you are viewing. Image links, though, are outlined in a blue rectangle, thus helping you recognize them as such. With both text and image links, you simply click the link to go to a new page. Image maps are not outlined in blue, but are usually recognizable due to the fact that they are composed of a variety of separate images grouped together, with each different image holding an obvious meaning. Many image maps are actual geographical maps, just like you would see in an atlas. You may, for instance, run across an image map of South Africa.

Clicking one of the provinces might take you to information about a company's offices and plants in that province. If you wonder if an image is an image map or not, just run your mouse across it and observe the changes in the status line of your browser. If it is an image map, different Web addresses appear in the status line as you move the mouse pointer across the image map. It is possible for Web designers to create links that do not look like the normal ones, and you will often find these on Web sites that use a magazine style for their layout, like the one in the figure on the bottom right. A basic rule is, if it looks like a table of contents, it's a set of links. To be certain, just move your pointer over a suspected link and see if a Web address appears in your status line.

Making notes from carefully read documents

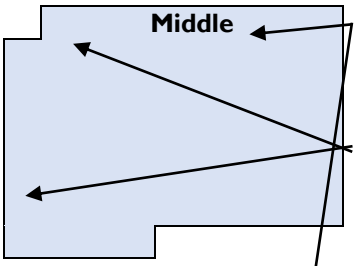
Reading a document carefully, so as to understand fully what it is about, is the first of the two main steps needed to make useful notes of a document. The second is, of course, to make the notes themselves.



Titles display brief summaries of the main theme or content of a document.

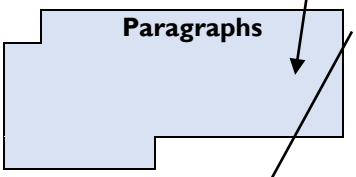
Opening paragraphs usually contain key data (remember: who, why, what, when, where) to provide a background, and introduce the subject of the document.

The first sentence of a paragraph often includes a key point in order to capture our interest and signal a theme for the document.

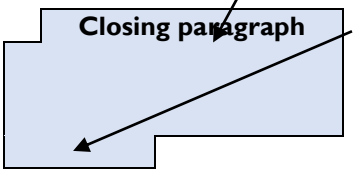


Middle paragraphs usually convey the detail of a document, and often start off with the most important point and finish with the least important.

In all paragraphs, a good place to check for key points is in their **opening and closing sentences**.



Closing paragraphs tend to summarise the detailed middle paragraphs and to make conclusions; in so doing they often act as mini summaries of the whole document.



Final sentences in articles also tend to contain an important point so that it stays in our memory, so check this location carefully.

Making notes of a document is, essentially, a process, which reverses what the document's author, did when writing it. Most authors go through these three main stages when writing a document:

- Rough ideas

- Structured into an outline series of points
- Written out in prose paragraphs

When a reader wishes to make notes of the same document, he or she needs to retrace the author's steps, by going back from the final stage three to the outline skeleton stage two. To do so involves the note-maker in stripping away the words, which are needed to express ideas in full sentences until the key, outline points are uncovered.

As we have already discovered, key meaning tends to lie in subjects, finite verbs and their extensions or objects. We also know where to focus an initial search for key data within the paragraphs or sections of any document. Much like the zoom feature in a word-processing package, we now need to zoom into a sentence or passage, which contains, say, two or three key points, in order to see how the process of identifying them using the parts of speech approach actually works: Study this passage carefully, reading it so as to extract its key meaning using the parts of speech approach:

How to make notes

In spite of a temptation to leap straight into the task, it pays to follow a careful series of steps in order to extract the key points from any article.

- Firstly, and very importantly, study the title of the document. It will provide a brief summary of the document's main theme. Then read the whole document through slowly and carefully, in order to obtain understanding of its overall content.
- Secondly, go back to the beginning and read the document again for the meaning of its individual words and phrases. Consult your dictionary when you meet an unfamiliar word and jot it's meaning down in your notebook. Do this for each section or paragraph of the document.
- Thirdly, read the document again in order to pick out the main point of each section or paragraph. You can do this by scanning over the document, since by now; you will have obtained a clear idea of what it is all about. Write down the points in note form as you identify them.

When you have completed this three-stage process of reading a document to extract it's meaning, you will be in an ideal position to write down a set of its key points.

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Analysing the reading for key meaning task

An analysis of the first paragraph shows how it helps to go first for the subjects, their finite verbs and either objects or extensions:

- It pays to follow ... a series of steps; ... you can extract ... the key points; ... (you) study the title of the document; It provides ... a summary of the main theme; ... read the document through to obtain understanding of its content; ... read the document (again) for the meaning of words and phrases.
- In the same way. The key word clusters of the second paragraph can be extracted: ... consult your dictionary; ... when you meet an unfamiliar word ... jot down its meaning; ... read the document again; ... etc.
- A glance at the following descriptive words (adjectives and adverbs) illustrates how much can be stripped out, without losing the passage's essential meaning
- careful... firstly and very importantly ... brief ... whole ... slowly and carefully ... overall... Secondly ... individual... in your notebook ... Thirdly ... etc.

Word clusters to skim over

As well as skimming over word clusters, which provide additional, but not essential descriptive information, it helps to leave out of consideration the following kinds of word clusters:

- Word clusters used to introduce or to link ideas together, which contain no important point:
  - In spite of a temptation to leap straight into the task,
  - Firstly, and very importantly
  - Secondly, go back to the beginning and

- Words or phrases which are repetitions or restatements of points already made:
  - Do this for each section or paragraph of the document.
  - Of reading a document to extract its meaning,

- Words or phrases which are examples or illustrations of a main point: such as a point made in the first sentence

In point of fact, the above worked example is fairly closely written, in that there are not very many word clusters, which are of secondary importance.

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Example of the notes made on the above passage

How to make notes

1. It pays to follow - a series of steps - to extract key points - from articles
2. Study title of document first - for brief summary of main theme
3. Then: read through all document - for understanding of overall content
4. Consult dictionary on unfamiliar words - jot down meanings
5. Read document again for main points - scan over paragraphs
6. Write down identified main points in note form
7. Three-stage process - ideal preparation for note-making

Summary of key points

How to take effective notes of reading material

- When reading a document for a purpose, read it three times: firstly, to get a general idea of its main theme and content, secondly to find out what any unfamiliar word or expression means, and thirdly to see how the main points are structured.
- Remember where to look for likely key points: the title, the first and last sentences of the piece, and the first and last sentences of each paragraph.
- Use the parts of speech and grammar functions of word clusters to identify the most important words and ideas in sentences, and disregard the descriptive words (for the most part - but not entirely).
- Make notes of the important word clusters you identify in brief bullet points - not as full as complete sentences but not so abbreviated that even you can't understand them at a later date!

VALUES, ATTITUDES AND ASSUMPTIONS IN TEXTS

Reading for meaning

After you've read an essay once, use the following set of questions to guide your re-readings of the text. The question on the left-hand side will help you describe and analyse the text; the question on the right-hand side will help focus your response(s).

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DESCRIPTION	RESPONSE
I. Purpose	
Describe the author's overall purpose (to inquire, to convince, to persuade, to negotiate or other purpose)	Is the overall purpose clear or muddled?
How did the essay or text actually affect you: did the author's purpose succeed?	How does the author want to affect or change the reader?
	Was the author's actual purpose different from the stated purpose?
II. Audience/Reader	
Who is the intended audience?	Are you part of the intended audience?
What assumptions does the author make about the reader's knowledge or beliefs?	Does the author talk to or talk down to the reader?
From what context or point of view is the author writing?	
III. Thesis and Main Ideas	
What question or problem does the author address?	Where is the thesis stated?
What is the author's thesis	Are the main ideas actually related to the thesis?
What main ideas are related to the thesis?	Do key passages convey a message different from the thesis?
What are the key moments or key passages in the text?	What assumptions (about the subject or about culture) does the author make?
	Are there problems or contradictions in the essay?
	What bothers or disturbs you about the essay?
	Where do you agree or disagree
IV. Organization and Evidence	
Where does the author preview the essay's organization?	Where did you clearly get the author's signals about the essay's organization?
How does the author signal new sections of the essay?	Where were you confused about the organization?
What kinds of evidence does the author use (experience, descriptions, statistics, other authorities, analytical reasoning, or other)?	What evidence was most or least effective?
	Where did the author rely on assertions rather than on evidence?
V. Language and Style	
What is the author's tone (casual, humorous, ironic, angry, preachy, distant, academic, or other)?	Did the tone support or distract from the author's purpose or meaning?
Are sentences and vocabulary easy, average or difficult?	Did the sentences and vocabulary support or distract from the purpose or meaning?

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What words, phrases, or images recur throughout the text?	Did recurring works or images relate to or support the purpose or meaning?

Critical reading techniques

The readings in most learnership writing courses explore issues we live with daily. As a reader, you bring a wealth of relevant opinions, experiences, and language strategies with you to your work. So, while the authors you read in learnerships may describe common experience from abstract positions or use evidence that is detailed and complex, in many ways the strategies you use to analyse and evaluate writing are similar strategies you use to understand other complex situations: You think about what will probably happen, you listen carefully to what's being offered, and you consider the offer and how it meets your needs. In the same way, you preview, read, and review the texts offered in this course.

The process: Previewing

Before reading, you need a sense of your own purpose for reading. Are you looking for background information on a topic you know a little bit about already? Are you looking for specific details and facts that you can marshal in support of an argument? Are you trying to see how an author approaches her topic rhetorically? Knowing your own purpose in reading will help you focus your attention on relevant aspects of the text. Take a moment to reflect and clarify what your goal really is in the reading you're about to do.

In addition, before reading, you can take steps to familiarize yourself with the background of the text, and gain a useful overview of its content and structure.

- Seek information about the context of the reading (the occasion – when and where it was published – and to whom it's addressed),
- Its purpose (what the author is trying to establish, either by explaining, arguing, analysing, or narrating), and
- Its general content (what the overall subject matter is).
- Take a look for an abstract or an author's or editor's note that may precede the article itself, and read any background information that is available to you about the author, the occasion of the writing, and its intended audience.

Once you have an initial sense of the context, purpose, and content, glance through the text itself, looking at the title and any subtitles and noting general ideas that are tipped off by these cues. Continue flipping pages quickly and scanning paragraphs, getting the gist of what material

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the text covers and how that material is ordered. After looking over the text as a whole, read through the introductory paragraph or section, recognizing that many authors will provide an overview of their message as well as an explicit statement of their thesis or main point in the opening portion of the text. Taking the background information, the messages conveyed by the title, note or abstract, and the information from the opening paragraph or section into account, you should be able to proceed with a good hunch of the article's direction.

Consider your purpose

- Are you looking for information, main ideas, complete comprehension, or detailed analysis?
- How will you use this text?
- Get an overview of the context, purpose, and content of the reading.
- What does the title mean?
- What can you discover about the "when," "where," and "for whom" of the article?
- What does background or summary information provided by the author or editor predict the text will do?
- What chapter or unit does the text fit into?
- Scan the text.
- Does there seem to be a clear introduction and conclusion? Where?
- Are the body sections marked? What does each seem to be about? What claims does the author make at the beginnings and endings of sections?
- Are there key words that are repeated or put in bold or italics?
- What kinds of development and detail do you notice? Does the text include statistics, tables, and pictures or is it primarily prose? Do names of authors or characters get repeated frequently?

Annotating a text

Whatever your purposes are for reading a particular piece, you have three objectives to meet as your read: to identify the author's most important points, to recognize how they fit together, and to note how you respond to them. In a sense, you do the same thing as a reader every day when you sort through directions, labels, advertisements, and other sources of written information.

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What's different in a learnership is the complexity of the texts. Here you can't depend on listening and reading habits that get you through daily interactions. So, you will probably need to annotate the text, underlining or highlighting passages and making written notes in the margins of texts to identify the most important ideas, the main examples or details, and the things that trigger your own reactions. Devise your own notation system. We describe a general system in a box close by but offer it only as a suggestion. Keep in mind, though, that the more precise your marks are and the more focused your notes and reactions, the easier it will be to draw material from the text into your own writing. But be selective: the unfortunate tendency is to underline (or highlight) too much of a text. The shrewd reader will mark sparingly, keeping the focus on the truly important elements of a writer's ideas and his or her own reactions.

Recall your purpose

- What are you looking for?
- How will you use what you find? Identify the weave of the text
- Double underline the author's explanation of the main point(s) and jot "M.P." in the margin. (Often, but not always, a writer will tell an engaged reader where the text is going.)
- Underline each major new claim that the author makes in developing the text and write "claim 1," "claim 2," and so on in the margin. x Circle major point, of transition from the obvious (subtitles) to the less obvious (phrases like however, on the other hand, for example, and so on).
- Asterisk major pieces of evidence like statistics or stories or argument note in the margin the kind of evidence and its purpose, for example, "story that illustrates claim." x Write "concl." in the margin at points where the writer draws major conclusions. Locate passages and phrases that trigger reactions.
- Put a question mark next to points that are unclear and note whether you need more information or the author has been unclear or whether the passage just sounds unreasonable or out-of-place.
- Put an exclamation point next to passages that you react to strongly in agreement, disagreement, or interest.
- Attach a post-it note next to trigger passages and write a brief reaction as you read. Having read through a text and annotating it, your goal in reviewing it is to re-examine the content, the structure, and the language of the article in more detail, in order to

confirm you sense of the author's purpose and to evaluate how well they achieved that purpose. When you review a piece of writing, you will often start by examining the propositions (main points or claims) the writer lays out and the support he or she provides for those propositions, noticing the order in which these arguments and evidence are presented.

- Making an informal outline that lists the main points, mapping out the essay, is one very effective way of reviewing a text. Here, a well-marked text will really save you time. As you work through your review, you should also tune in to the rhetorical choices the author has made, analysing how the article is put together. Ask yourself what the writer is actually claiming, and why she or he organized the piece in this way. What does the introduction accomplish? What functions do the individual paragraphs serve? What patterns of thinking does the author use to drive home the main points? Your notes already tell you what the writer says; you're now getting at what the writing does. You will also want to make note of the tone and attitude used to support and elaborate the writer's view. Is the writer serious or humorous? How can you tell? Does the writer seem to be offering only information or stating an opinion and backing it up? How do you know? Keep returning to the text for specific examples. Finally, as you review the text, sorting out its organization and analysing its rhetorical moves, evaluate the effectiveness of the text and the validity of the claims and evidence. At this point you're judging for yourself whether the initial promise of the article has been kept and how the writer's values stack up against yours. To keep track of your ideas, use your journal: identify any questions you have after this re-reading, and note any insights the reading has provoked in you.

The process: Reviewing

As you review texts, let the reading situation guide you. While each of the following strategies uncovers one aspect of a text, you may decide not to work with all of them or to work in this order. Also, don't get caught up in finding the right answers to a specific set of questions. There is almost always more than one-way to sort out a piece of writing.

Organize the text

- Use the main point and claims that you have identified to create a simple outline, and then put the transitions and conclusions the writer makes in their place on the outline.

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- Give a name to each subsection and explain what writer "says" in the section and also what the section "does" to advance the flow of the text.
- Write a paragraph description of the overall pattern of the text. Feel the text.
- Write a paragraph that explores the attitude of the writer. Is she or he being serious, humorous, angry, ironic, informative, argumentative, combative.
- Skim through the text and find evidence of the attitude you suspect. Analyse the text.
- Write on your outline brief one or two sentence explanations of how each part of the text — claim or pieces of evidence, transitions — connects to each other part
- In a paragraph, explain how each part accomplishes the writer's purpose. Evaluate the text.
- In your journal, review what you know about the author and the publication. Are they trustworthy sources for the topic? Does the writer or publication have an obvious bias?
- Review the evidence you noticed. Is there enough of it? Is each claim supported? Is the evidence concrete, referring verifiable examples, statistics, and research?
- Review the claims the writer makes. Are they clear and logically coherent? Do they all relate to the topic? React to the text. x List the points that trigger a reaction in you.
- Free write a brief response to each trigger point. What reaction did you have on your first reading? What do you need to better understand? What is interesting to you?

There isn't anything especially mysterious about this reading process. The main point here is that you can discover writers' purposes, find your way into their audiences, and carry on a dialogue with them. And you can engage reading and writing projects with greater power — greater understanding and efficiency — if you preview the text, read it with a purpose and a plan, and review the text carefully after you've read it. When readers try to make sense of more complex texts by starting at the first sentence and reading straight through, they tend to get hung up, missing the forest for the trees. Spending your energy reading a whole text again and again without previewing it, thinking about its title and other kinds of cues, and forming some hunches about its general organization and content is likely to be wasted effort, because you won't get to the core of a text's meanings or see its larger significance and themes. Readers who quit reading because the text seems to make no sense should alter their reading strategy. Most of the learners that we know don't have a lot of time to waste. Work smart.

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Preview, annotate, and re-read.

What is the source of the material?

Just as you might check the brand label on an item of clothing before you buy it, so should you check to see where an article or essay comes from before you read it? You will often be asked to read material that is not in its original form. Many textbooks, such as this one, include excerpts or entire selections borrowed from other authors. Instructors often photocopy articles or essays and distribute them or place them on reserve in the library for students to read.

A first question to ask before you even begin to read is: What is the source-from what book, magazine, or newspaper was this taken? Knowledge of the source will help you judge the accuracy and soundness of what you read. For example, in which of the following sources would you expect to find the most accurate and up-to-date information about computer software?

- An advertisement in Time
- An article in Reader's Digest
- An article in Software Review

The article in Software Review would be the best source. This is a magazine devoted to the subject of computers and computer software. Reader's Digest, on the other hand, does not specialize in anyone topic and often reprints or condenses articles from other sources. Time, a weekly newsmagazine, does contain information, but a paid advertisement is likely to provide information on only one line of software. Knowing the source of an article will give clues to the kind of information the article will contain. For instance, suppose you went to the library to locate information for a research paper on the interpretation of dreams. You found the following sources of information. What do you expect each to contain?

- An encyclopaedia entry titled "Dreams"
- An article in Oprah Magazine titled "A Dreamy Way to Predict the Future"
- An article in Psychological Review titled "An Examination of Research on Dreams"

You can predict that the encyclopaedia entry will be a factual report. It will provide a general overview of the process of dreaming. The Oprah Magazine article will probably focus on the use of dreams to predict future events. You can expect the article to contain little research.

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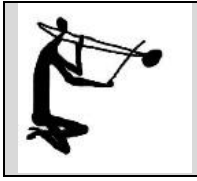
Most likely, it will be concerned largely with individual reports of people who accurately dreamt about the future. The article from Psychological Review, a journal that reports research in psychology, will present a primarily factual, research-oriented discussion of dreams. As part of evaluating a source or of selecting an appropriate source, be sure to check the date of publication. For many topics, it is essential that you work with current, up-to-date information. For example, suppose you've found an article on the safety of over-the-counter, non-prescription drugs. If the article was written four or five years ago, it is already outdated. New drugs have been approved and released; new regulations have been put into effect; packaging requirements have changed. The year a book was published can be found on the copyright page. If the book has been reprinted by another publisher or has been reissued in paperback, look to see when it was first published and check the year(s) in the copyright notice.



Individual Activity 1

What is the authority of the author

The qualifications of the author to write about the subject are another clue to the reliability of the information. If the author lacks expertise in or experience with a subject, the material may not be accurate or worthwhile reading. In textbooks, the author's credentials may appear on the title page or in the preface. In non-fiction books and general market paperbacks, a summary of the author's life and credentials may be included on the book jacket or back cover. In many other cases, however, the author's credentials are not given. You are left to rely on the judgment of the editors or publishers about an author's authority. If you are familiar with an author's work, then you can anticipate the type of material you will be reading and predict the writer's approach and attitude toward the subject. If, for example, you found an article on world banking written by former President Mandela, you could predict it will have a political point of view. If you were about to read an article on John Lennon written by Ringo Starr, one of the other Beatles, you could predict the article might possibly include details of their working relationship from Ringo's point of view.

Individual Activity 2

Does the writer make assumptions?

An assumption is an idea, theory, or principle that the writer believes to be true. The writer then develops his or her ideas based on that assumption. Of course, if the assumption is not true or is one you disagree with, then the ideas that depend on that assumption are of questionable value. For instance, an author may believe that the death penalty is immoral and, beginning with that assumption, develop an argument for different ways to prevent crime. However, if you believe that the death penalty is moral, and then from your viewpoint, the writer's argument is invalid. Read the following paragraph. Identify the assumption the writer makes, and write it in the space provided. The evil of athletic violence touches nearly everyone. It tarnishes what may be our only religion. Brutality in games blasphemes play; perhaps our purest form of free expression. It blurs the clarity of open competition, obscuring our joy in victory as well as our dignity in defeat. It robs us of innocence, surprise, and self-respect. It spoils our fun.

Assumption:

_____

Here the assumption is stated in the first sentence – the writer assumes that athletic violence exists. He makes no attempt to prove or explain that sports are violent. He assumes this and goes on to discuss its effects. You may agree or disagree with this assumption.

Individual Activity 3

Is the author biased

As you evaluate any piece of writing, always try to decide whether the author is objective or one-sided (biased). Does the author present an objective view of the subject or is a particular viewpoint favoured! An objective article presents all sides of an issue, while a biased one presents only one side.

You can decide whether asking yourself these questions biases a writer:

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1. Is the writer acting as a reporter, presenting facts, or as a salesperson, providing only favourable information?
2. Are there other views toward the subject that the writer does not discuss?

Use these questions to determine whether the author of the following selection is biased: Teachers, schools, and parent associations have become increasingly concerned about the effects of television on school performance. Based on their classroom experiences, many teachers have reported mounting incidences of fatigue, tension, and aggressive behaviour, as well as lessened spontaneity and imagination. So, what have schools been doing? At Marble Hall Farm School in Mpumalanga, parents and teachers have been following written guidelines for five years, which include no television at all for children through the first grade. Children in second grade through high school are encouraged to watch no television on school nights and to restrict viewing to a total of three to four hours on weekends. According to Amos Msimango, head of the faculty, "You can observe the effects with some youngsters almost immediately. Three days after they turn off the set you see a marked improvement in their behaviour. They concentrate better, and are more able to follow directions and get along with their neighbours. If they go back to the set you notice it right away." As Solly Ranamane has pointed out, "In the final analysis, the success of schools in minimizing the negative effects of television on their (children's) academic progress depends almost entirely on whether the parents share this goal."

The subject of this passage is children's television viewing. It expresses concern and gives evidence that television has a negative effect on children. The other side of the issue – the positive effects or benefits – is not mentioned. There is no discussion of such positive effects as the information to be learned from educational television programs or the use of television in increasing a child's awareness of different ideas, people, and places. The author is biased and expresses only a negative attitude toward television. Occasionally, you may come upon unintentional bias – bias that the writer is not aware of. A writer may not recognize his or her own bias on cultural, religious, or sexual issues.

Is the writing slanted

Slanting refers to the selection of details that suit the author's purpose and the omission of those that do not. Suppose you were asked to write a description of a person you know. If you wanted a reader to respond favourably to the person, you might write something like this:

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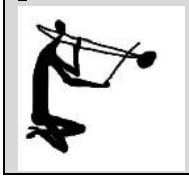
Alex is tall, muscular, and well built. He is a friendly person and seldom becomes angry or upset. He enjoys sharing jokes and stories with his friends.

On the other hand, if you wanted to create a less positive image of Alex, you could omit the above information and emphasize these facts instead: Alex has a long nose and his teeth are crooked. He talks about himself a lot and doesn't seem to listen to what others are saying. Alex wears rumpled clothes that are too big for him. While all of these facts about Alex may be true, the writer decides which to include. Much of what you read is slanted. For instance, advertisers tell only what is good about a product, not what is wrong with it. In the newspaper advice column, Dear Abby gives her opinion on how to solve a reader's problem, but she does not discuss all the possible solutions. As you read material that is slanted, keep these questions in mind: 1. What types of facts has the author omitted? 2. How would the inclusion of these facts change your reaction or impression?

	**Individual Activity 4**

How does the writer support his or her ideas?

Suppose a friend said he thought you should quit your part-time job immediately. What would you do? Would you automatically accept his advice, or would you ask him why? No doubt you would not blindly accept the advice but would inquire why. Then, once you heard his reasons, you would decide whether they made sense. Similarly, when you read, you should not blindly accept a writer's ideas. Instead, you should ask why by checking to see how the writer supports or explains his or her ideas. Then, once you have examined the supporting information, decide whether you accept the idea. Evaluating the supporting evidence, a writer provides involves using your judgment. The evidence you accept as conclusive may be regarded by someone else as insufficient. The judgment you make depends on your purpose and background knowledge, among other things.

In judging the quality of supporting information, a writer provides, you should watch for the use of:

1. Generalizations,

2. Statements of opinion,
3. Personal experience, and
4. Statistics as evidence.

Generalizations

What do the following statements have in common?

1. Dogs are vicious and nasty.
2. College students are more interested in having fun than in learning.
3. Parents want their children to grow up to be just like them.

These sentences seem to have little in common. But although the subjects are different, the sentences do have one thing in common: each is a generalization. Each makes a broad statement about some group (college students, dogs, parents). The first statement says that dogs are vicious and nasty. Yet the writer could not be certain that this statement is true unless he or she had seen every existing dog. No doubt the writer felt this statement was true based on his or her observation of and experience with dogs.

A generalization is a statement that is made about an entire group or class of individuals or items based on experience with some members of that group. It necessarily involves the writer's judgment. The question that must be asked about all generalizations is whether they are accurate. How many dogs did the writer observe and how much research did he or she do to justify the generalization? Try to think of exceptions to the generalization; for instance, a dog that is neither vicious nor nasty. As you evaluate the supporting evidence a writer uses, be alert for generalizations that are presented as facts. A writer may, on occasion, support a statement by offering unsupported generalizations. When this occurs, treat the writer's ideas with a critical, questioning attitude.

	**Individual Activity 5**

	**Individual Activity 6**

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Statements of opinion

Facts are statements that can be verified. They can be proven to be true or false. **Opinions** are statements that express a writer's feelings, attitudes, or beliefs. They are neither true nor false. Here are a few examples of each:

Facts

1. My car insurance costs R1500.
2. The theory of instinct was formulated by Konrad Lorenz.
3. Green peace is an organization dedicated to preserving the sea and its animals.

Opinions

1. My car insurance is too expensive.
2. The slaughter of baby seals for their pelts should be outlawed.
3. Population growth should be regulated through mandatory birth control.

The ability to distinguish between fact and opinion is an essential part of evaluating an author's supporting information. Factual statement from reliable sources can usually be accepted as correct. Opinions, however, must be considered as one person's viewpoint that you are free to accept or reject.

Individual Activity 7

Personal experience

Writers often support their ideas by describing their own personal experiences. Although a writer's experiences may be interesting and reveal a perspective on an issue, do not accept them as proof. Suppose you are reading an article on drug use and the writer uses his or her personal experience with particular drugs to prove a point. There are several reasons why you should not accept the writer's conclusions about the drugs' effects as fact.

First, the effects of a drug may vary from person to person. The drug's effect on the writer may be unusual. Second, unless the writer kept careful records about times, dosages, surrounding circumstances, and so on, he or she is describing events from memory. Over time, the writer may have forgotten or exaggerated some of the effects. As you read, treat

ideas supported only through personal experience as one person's experience. Do not make the error of generalizing the experience.

Statistics

People are often impressed by statistics-figures, percentages, averages, and so forth. They accept this as absolute proof. Actually, statistics can be misused, misinterpreted, or used selectively to give other than the most objective, accurate picture of a situation. Here is an example of how statistics can be misused. Suppose you read that magazine X increased its readership by 50 percent, while magazine y had only a 10 percent increase. From this statistic some readers might assume that magazine X has a wider readership than magazine Y. The missing but crucial statistic is the total readership of each magazine prior to the increase. If magazine X had a readership of 20,000 and this increased by 50 percent, its readership would total 301000. If magazine Y's readership was already 50,000, a 10-percent increase, bringing the new total to 55,000, would still give it the larger readership despite the fact of the smaller increase. Even statistics, then, must be read with a critical, questioning mind.

South Africans in the work force are better off than ever before. The average salary of the South African worker is R30,000 per year.

At first, the above statement may seem convincing. However, a closer look reveals that the statistic given does not really support the statement. The term average is the key to how the statistic is misused. An average includes all salaries, both high and low. It is possible that some South Africans earn R5,000 while others earn R250,000. Although the average salary may be R30,000, this does not mean that everyone earns R30,000.

Individual Activity 8

Does the writer make value judgments?

A writer who states that an idea or action is right or wrong, good or bad, desirable or undesirable is making a value judgment. That is, the writer is imposing his or her own judgment on the worth of an idea or action. Here are a few examples of value judgments:

- Divorces should be restricted to couples that can prove incompatibility.

- Abortion is wrong.
- Welfare applicants should be forced to apply for any job they are capable of performing.
- Premarital sex is acceptable.

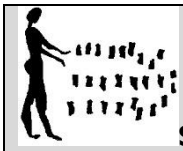
You will notice that each statement is controversial. Each involves some type of conflict or idea over which there is disagreement:

- Restriction versus freedom
- Right versus wrong
- Force versus choice
- Acceptability versus non-acceptability.

You may know of some people who would agree and others who might disagree with each statement. A writer who takes a position or side on a conflict is making a value judgment. As you read, be alert for value judgments. They represent one person's view only and there are most likely many other views on the same topic. When you identify a value judgment, try to determine whether the author offers any evidence in support of the position.

	**Individual Activity 9**

	**Individual Activity 10**



SUMMATIVE 5

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